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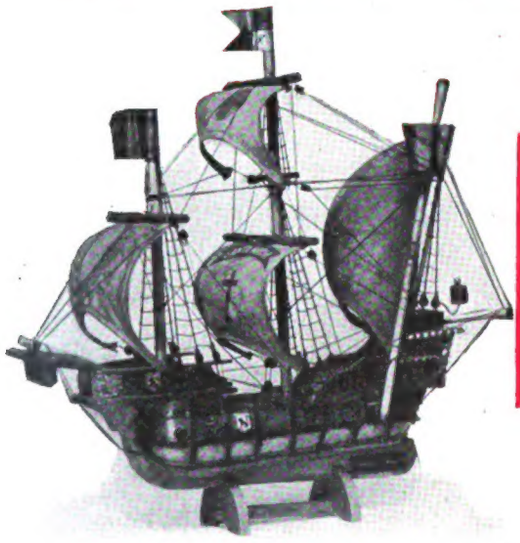

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What do you think our large cities and the world in general will look like at that future time? Take a look into the future with the author of this article.

Mechanical Devices Animals Use

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Testing Dams to Bursting Point

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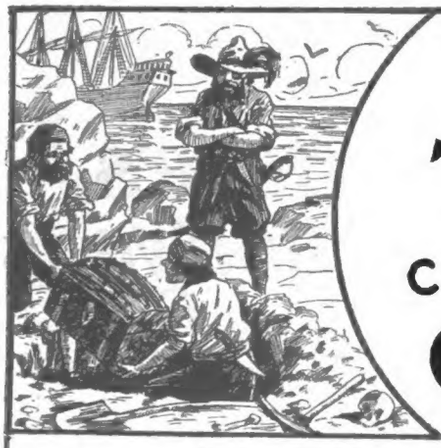

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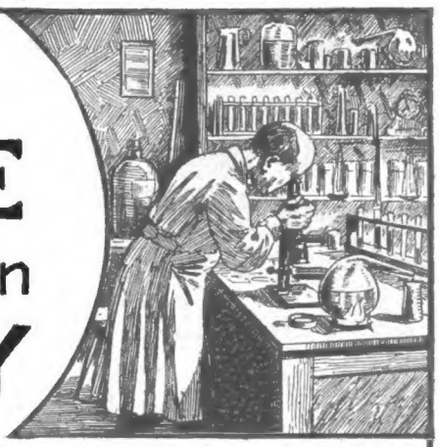

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Whole No. 168

Science and Invention

April, 1927
No. 12

HUGO GERNSBACK, *Editor-in-Chief*
H. WINFIELD SECOR, *Managing Editor*
DR. T. O'CONOR SLOANE, Ph.D., *Associate Editor*
Editorial and General Offices, - - - 230 Fifth Avenue, New York

"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" - - - HUXLEY

LEARN TO KNOW YOURSELF

By HUGO GERNSBACK

SOMEWHERE some one said that by the time you arrive at the age of forty you will be either dead or a doctor. By that is meant that in order to survive, enough knowledge must have been absorbed to take care of the human machine, or you will not live. This is quite true.

Two of the most pernicious things possible in life are habit, and the disregard of weather signs as related to the human body. It takes the human body a long time to find out what agrees with it and what not. There are no two people with whom the same thing agrees in a like manner. For instance, when it comes to eating, certain things will make some people sick while on others they will have no effect. Nevertheless these factors are usually disregarded and most people, even though they do know that a thing disagrees with them, blithely go on partaking of the same food, until it suddenly makes them ill enough, and only then perhaps they stop.

Then a strange thing happens. Maybe after a lapse of five or more years the same substance that made one ill can be eaten without it doing any harm whatsoever. The reason, of course, is—and few people realize this—that the human body does not stay the same year after year, but changes; and what was good for the system last year may not necessarily be good at a later period. The rational thing, therefore, is to experiment, if necessary, with small doses, to find out what agrees and what does not. These remarks apply just the same to medicines as to food, both internal medicines and medicines applied externally. In the latter case, for instance, there are a number of people who can not stand iodine, which seems to poison them, while with most people it has no deleterious effects.

The human body is a marvelous machine, and as one scientist once put it, it is surprising how much it really takes to kill a human being. In other words, the human machine will take an incredible amount of punishment, and abuse, much more than a man-made machine will absorb, and, as a rule, the human machine will outlast the best man-made machines, although the latter may be constructed of the strongest metals, whereas the human machine would at first glance appear to be frail.

I have said before that it is the pernicious habits we form that always keep interfering with the smooth working of the human machinery. There are many things which we know we should do and which we persist in not doing. We know, for instance, that we should drink at least six tumblers of water per day in order to lubricate the machinery, but how many of us do this? Only when we become advanced in age, and when our kidneys, heart or bladder begin to be troubled, do we realize that water, the universal solvent, is one of the most important substances which, *alone*, if taken judiciously, will lengthen our lives to no mean degree.

At the present time one of the diseases which kills most people is heart disease. This is usually attributed by medical science to the high pressure of modern living, which draws upon the nervous vitality and calls for very much harder work for the heart. Volumes might be written on this subject of how to overcome this almost universal scourge. It might be mentioned that worrying is probably one of the greatest contributing reasons for heart failure, and this, coupled with the high pressure of modern life, taxes this usually sturdy organ to capacity.

It is possible, as has been proved by experience, to train oneself not to worry. It is not a simple matter to acquire this habit, which is simply a psychic condition, but it is possible to acquire it, although it takes a good deal of training and will power to do so.

The next time you are worrying about something, try the simple remedy of immediately relaxing and *pushing* the worrying thought clear from your mind, by thinking of the first pleasant thing that you know of. You will find, after trying this a few times, that it will accomplish wonders, and that your heart action will be greatly improved.

Physical well-being, however, is not the only thing that counts. Mental well-being is just as important. Few people know the power of their own minds, or know what actually can be accomplished by training. A great many of the human functions take place automatically, and are regulated by our own subconsciousness. Thus, for instance, breathing, the heart beat, digestion, and many other bodily functions are carried out automatically, but many others can be acquired.

Thus, for instance, when you wish to get a drink of water, you do not consciously think of the following most complicated action: It becomes necessary to move your legs in order to walk over to the water receptacle. Your arm is then commanded to reach out and lift up a glass from its proper place. Simultaneously the fingers are made to grasp the glass. The other hand is then ordered to first reach out, then turn the faucet, making the water flow, when another command places the glass under the flowing stream. A further order shuts off the water faucet when the glass is filled. The next command brings the glass to your lips. A further order opens the mouth, when still another command makes you throw your head back, after which the glass is inverted partially and the water is imbibed.

The action by no means stops here, because the water is still to be swallowed, in which a special action takes place, after which the digestive and filter organs of the body are called into action to absorb the water.

All of this sounds commonplace and at the same time extremely complicated, but just the same all of these and hundreds of other complicated actions are done by us unthinkingly, day in and day out, because they have been acquired by practice. For instance, a year-old child could not perform them because it has not acquired experience enough or gone through the various actions a sufficient number of times to thoroughly learn them. It is the same with all other actions, which, if they have been found beneficial, can be acquired.

The power of mind over body is tremendous, but we do not use it enough.

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NEW IDEAS AND MECHANISMS IN LARGEST THEATER

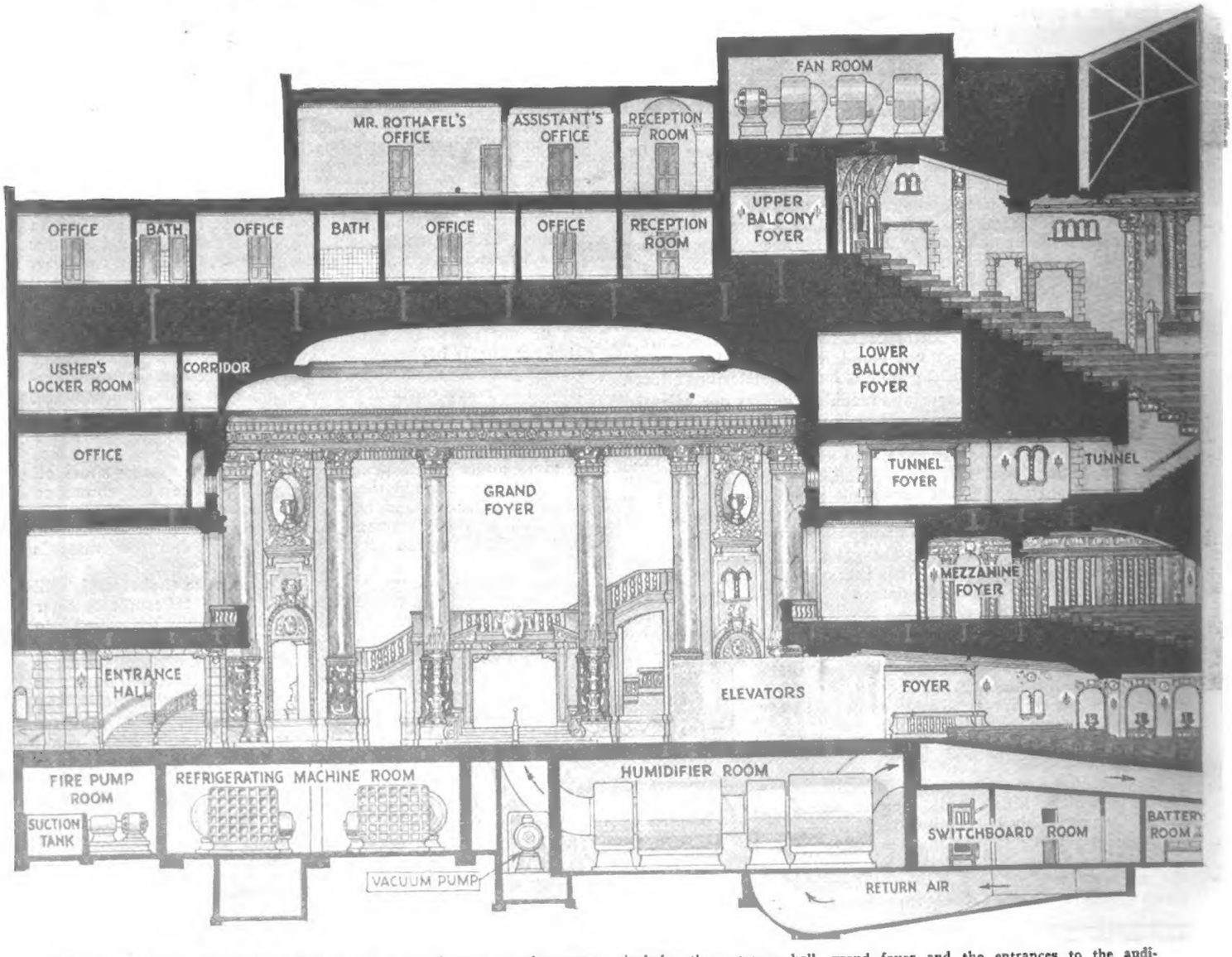
By JAMES FRANCIS

The magnificent new Roxy Theater is situated on 50th Street near 7th Avenue, New York City, in a region which promises to be the future theatrical center of America. Above, the exterior of the theater.

THEATERS may come and theaters may go, but the newest theater always shows a tendency toward the Bigger and Better. Each new palace of amusement has some particular outstanding feature which elevates it above the general run of theaters. Thus we had, a few months ago the "World's Finest Theater," and now along comes another which claims among other attributes the distinction of being "The Largest Theater in the World." It is the culmination of years of planning and preparation, and it contains all the latest and best which human ingenuity could evolve toward creating a more beautiful place for the presentation of motion pictures.

New York has an immense number of theaters, several hundreds of them, in fact, but it has comparatively few which are really fine or large. New York's theaters, in general, are far outclassed by those of Chicago, Los Angeles, Buffalo, Boston and several other metropolitan cities. It is only within the last three or four years that plans have been made to give Broadway the type of theatre which it should have as the theatrical center of America.

The Capitol was the first great motion picture theater, and it is still one of the sights of New York. Somewhat later, the immense Hippodrome was converted into a motion picture and vaudeville house. Then came the long-heralded Paramount. Each of these houses presented innovations which appealed greatly to the theater-going public, and, as a result, the announcement of the



The drawing across the bottom of these two pages shows a complete cross section of the new Roxy Theater building, indicating a number of very interesting features. On this page is the portion of the theater which includes the entrance hall, grand foyer and the entrances to the auditorium. The refrigerating and ventilating mechanism is installed, as will be seen, below the foyer.

IN THE WORLD

BUILT BY FAMOUS RADIO FAVORITE

CLEMENGER

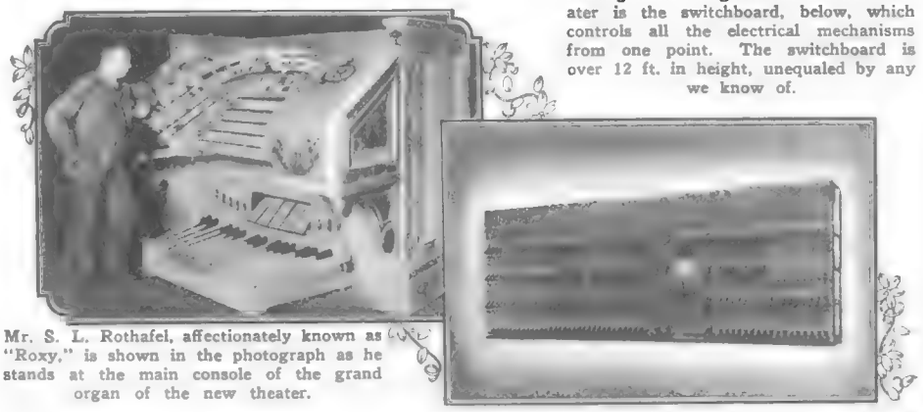
opening of any new theater is sure to cause anticipation of new delights and comforts.

It remained for one of America's greatest showmen, Mr. S. L. Rothafel—known to radio listeners throughout the country as "Roxy"—to conceive a theatrical organization dedicated to the presentation of feature motion pictures which would overshadow everything which had been attempted before in this work. Mr. Rothafel started his metropolitan career at the Capitol Theater, where he was director for a number of years. Some time ago he resigned from this organization so that he might devote himself to the financing and development of the wonderful new theater which bears his name.

On March 4th of this year, Mr. Rothafel realized the accomplishment of his amazing plan, when a distinguished first-night audience attended the most unusual performance which Broadway has seen for many a year—the inaugural program of the Roxy Theater.

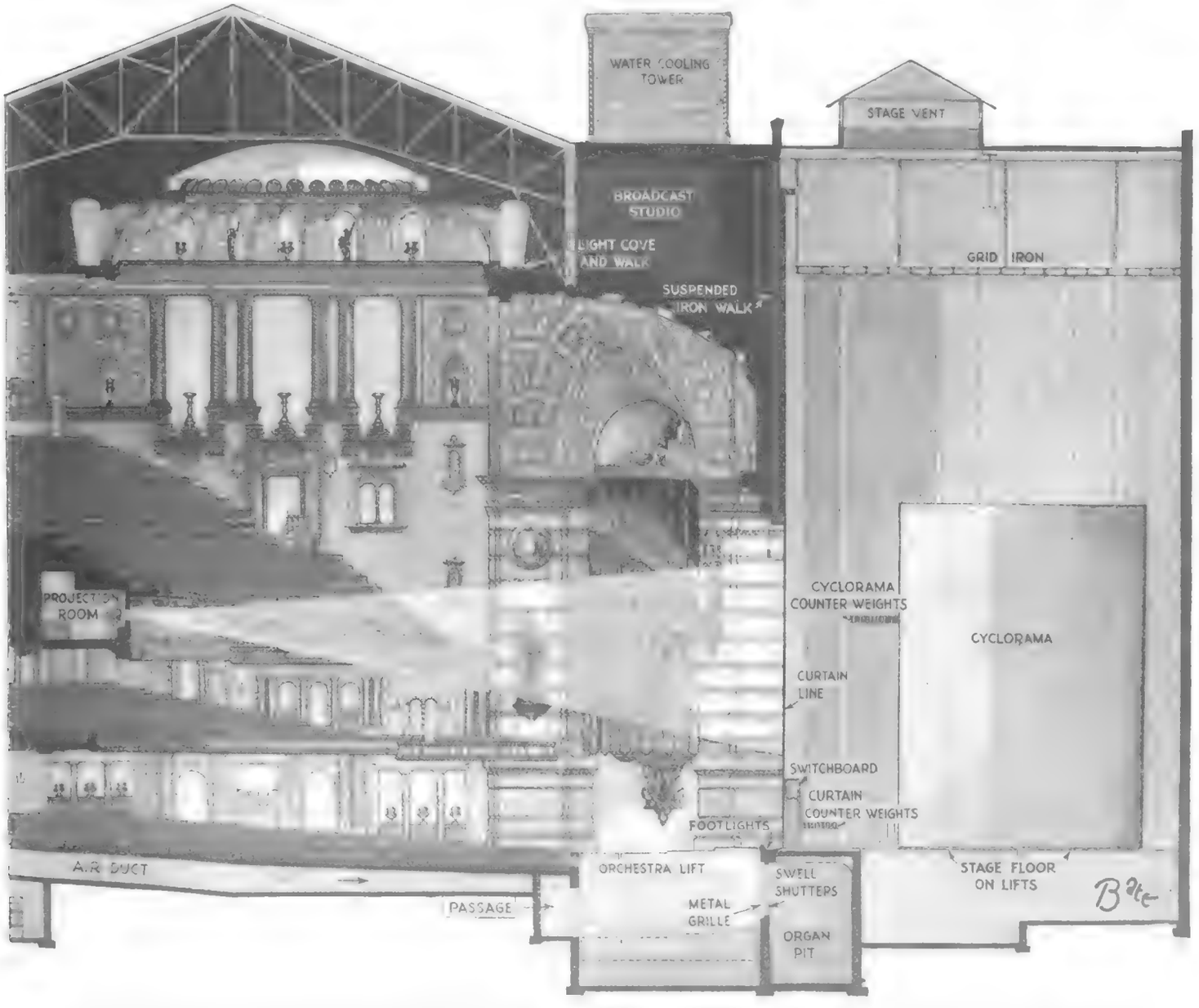
THE THEATER

The Roxy Theater, situated on Seventh Avenue, between 50th and 51st Streets, has a seating capacity of 6,000 and accommodates 10,000, all portions of the house included. It is, by quite a margin, the largest



Mr. S. L. Rothafel, affectionately known as "Roxy," is shown in the photograph as he stands at the main console of the grand organ of the new theater.

Among other "largests" in the new theater is the switchboard, below, which controls all the electrical mechanisms from one point. The switchboard is over 12 ft. in height, unequaled by any we know of.



It may be easily seen that the auditorium incorporates a number of new and radical innovations in design. The stage is located in the corner of the approximately square auditorium, and this stage is made the center of interest of the entire theater. The auditorium is lighted entirely from the stage, as shown elsewhere. The stage and orchestra pit are provided with elevating mechanism illustrated elsewhere.

Magnificent Theater Accomodates 10,000 Patrons

motion picture theater in the world, and it is equipped with every conceivable mechanism which would aid in the presentation of feature photoplays and incidental programs. The theater building is divided into three main sections: The Lobby, the Auditorium and the Production Department.

As one enters the theater from the Seventh Avenue doorways, the first impression is one of imperial richness and excellent taste. The Grand Foyer is oval in shape, flanked on one side by a broad, curving stairway which leads to the upper level, and surrounded on all sides by massive columns rising to a vaulted roof.

The Auditorium is upon the left as one enters the Foyer, and is separated from the Foyer by a Lobby The Auditorium is nothing less than immense. It achieves an effect of grandeur without the appearance of coldness, and the color effects are most striking. According to Mr. Rothafel, the idea of the architectural arrangement of the Auditorium is to give the impression of an immense, inverted, hammered-bronze bowl. The general shape of the Auditorium is roughly that of a square. The stage is most peculiarly situated when compared with that of the usual movie house. It is placed in one corner of the Auditorium, with the seats ranging back, tier on tier, from the level of the orchestra floor to the balcony 100 feet above.

One of the most interesting features, from the standpoint (or should we say "sitpoint"?) of the fan is that the seats are luxuriously upholstered, and plenty of room is allowed between rows to make it unnecessary for patrons to rise for others passing.

There is not a seat in the house which has not a perfect view of the stage and which is not placed so that every sound can be heard clearly. It is amazing to realize how close the most remote seats are to the stage, this being made possible through the utilization of so much space which is wasted in the usual theater.

The auditorium of the Roxy Theater presents an appearance without parallel in the history of the stage. The general impression is that of an immense, inverted hammered-bronze bowl suffused by the radiance of concealed flood lights. The lights are concealed in a pit immediately in front of the footlights, whence their rays are projected through diffusing screens to illuminate the entire auditorium.

THE STAGE

Many sleepless nights were spent by the stage contractors in developing Mr. Rothafel's ideas into practical shape. The stage is always the center of interest in any theater, and in a theater of this type it is particularly worthy of the greatest attenion to detail in designing. The engineers decided that it would be wise to build the stage in sections, so that portions of it could be elevated or depressed at will. To accomplish this, it was necessary to construct a deep well of brick and cement, reinforced by concrete, into which the two sections—front and rear—could descend on electric elevators. A permanent cyclorama was first suggested, but it was found possible to build one out of steel and concrete which could be raised into the flies just as a piece of scenery might be dealt with. A glance at the sectional drawing on the foregoing pages will indicate more plainly some of these features.

ELECTRICAL EQUIPMENT

The entire electrical equipment of the theater is operated from a master control switchboard, situated in the wings at the left of the stage. This switchboard, which is the largest in the world, has controls and rheostats for all the lighting circuits, and the entire electrical mechanism of the stage and auditorium. Master controls are provided to simplify the control for special effects or routine lighting.

One of the engineering features of peculiar interest is the lighting system. This is very unusual, as the entire auditorium is lighted from the stage. The theory is that the stage is the center of interest in the theater, and every effort should be made to concentrate attention on that nucleus. With floods arranged as they are in a pit in front of the footlights, it is possible to produce marvelous effects and keep the attention of the audience confined to the scene of action.

Exit lights are of course used, but every effort is made to keep from distracting the patrons' attention from the performers by eliminating all lights which are not absolutely necessary.

The stage elevating mechanism, the organ consoles, and the scenery shifting mechanism, are all controlled from the main switchboard and from elsewhere by relays.

The ventilating system is a very complete unit, located in the basement immediately under the auditorium. Pure dry air is introduced into the auditorium under pressure from a number of ducts scattered throughout the wall and ceiling, and the waste air is drawn out through similar openings. The capacity of the cooling plant is sufficient to provide a constant moderate temperature during the hottest summer months and the January ice.

THE GREAT ORGAN

An entirely new idea is tried out for the first time in the installation of the Roxy organs. One immense organ is arranged under the stage so that when it is played the sound sweeps out from the orchestra pit exactly the way it does when the orchestra itself is playing. The organ may be controlled by one organist from any of three consoles in different positions in the orchestra pit, or it may be controlled by three organists playing at the same time. This latter feature is peculiar to this theater alone, and should provide the musical director with an opportunity for unusual and striking effects. The organ installation is said to be one of the most complete to be found anywhere in the world.

PRODUCTION DEPARTMENTS

The production and executive departments are housed in offices and various special rooms situated throughout those portions of the building not occupied by the theater proper. Among other interesting special departments might be mentioned a complete tailor shop, kitchens and dining halls, baths for employees, magnificent offices for the executive staff, and rehearsal and practice rooms for the artists and directors.

Above the theater is found the broadcasting studio, where "Roxy and His Gang" enact their internationally famous broadcasting programs. It is through this medium, the radio, that Roxy will reach the greater portion of the American public, but the theater alone is sufficient to attract visitors from all over the world, who have heard of the wonderful co-operation and hard work that have made this project possible.

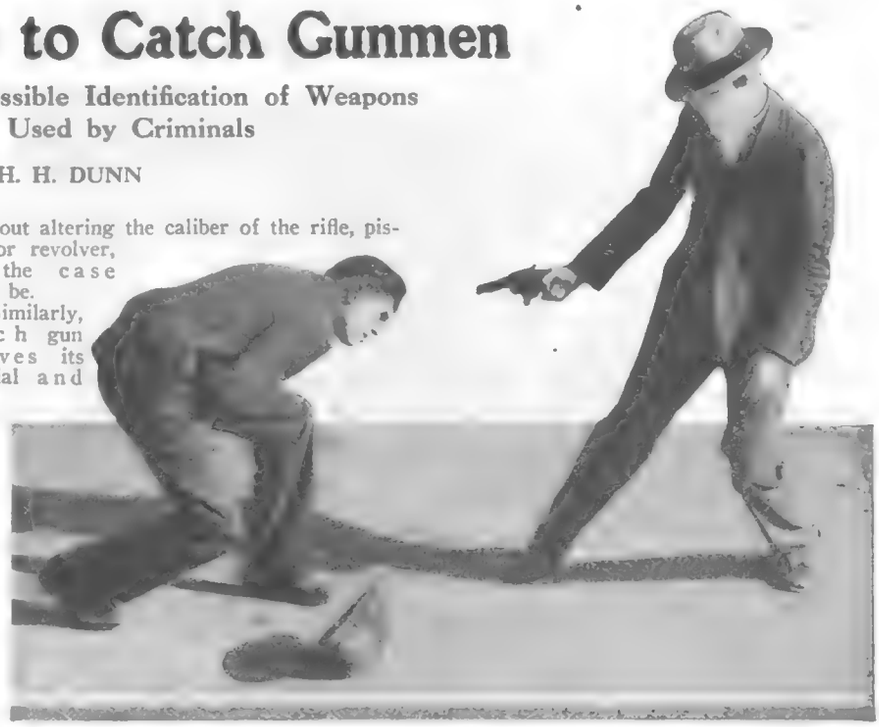
The writer was privileged to visit the Roxy Theater about a month before its opening.

(*Continued on Page* 1144)

Gunprints Help to Catch Gunmen

New Science Makes Possible Identification of Weapons and Bullets Used by Criminals

By H. H. DUNN



If the bullet can be found, the gun which fired it can be identified. This makes easy the first, longest and hardest step in the discovery of the criminal. Every bullet ever fired from revolver or rifle bears its own tell-tale markings.

AT three o'clock of a dark morning a patrolman saw a negro working on a store lock. He called on the marauder to throw up his hands, at the same time drawing his own gun. The burglar wheeled, whipped out an automatic and sent a bullet into the right arm of the policeman, rendering him unable to use his own weapon. The negro escaped.

Three weeks later the criminal was caught, identified, convicted and sentenced, all because of a line, finer than any hair, invisible to the unaided eye, scratched on the bullet extracted from the policeman's arm.

A few days later a wealthy bootlegger and a young woman were found shot to death in the girl's apartment. One bullet had killed each, but there was a third bullet embedded in a wall. There were guns aplenty in the apartment; none had been fired. A week later a man was found shot to death on a lonely road near the city in which the rum-runner and his "girl" had been killed. From the bullet in the wall, the slain man was identified as the murderer of the pair. From a bullet taken from the body of the lone dead man, his murderer was identified, caught, and charged with the murder. He confessed that he had waylaid and killed the second man because he knew that his victim had shot to death the bootlegger and the woman.

Method of studying and recording "gunprints." At the left is the camera by which the pictures shown herewith were made. At right is the delicate measuring gauge and holder whereby the tell-tale gunprints are found and identified. In the center is Philip Richardson, expert in the new study, who has formulated a system, similar to that in use for fingerprints, whereby weapons may be identified by either bullet or cartridge, or both.

Both criminals were identified, and one of them caught, from that same fine line on each bullet.

These incidents occurred in two cities on San Francisco Bay. They are practical exemplifications of the results of the new science of gunprints. In criminology this development bears the same relation to weapons that finger prints bear to the criminal users of these weapons. In both instances, it was used by a young graduate of the University of California, Philip Richardson, working in the new and novel department of forensic ballistics, established by August Vollmer, chief of police of Berkeley. Incidentally, all the members of the police force of the university city, which has about 75,000 inhabitants, are university graduates.

The principle of the new science is that every gun leaves its own individual mark on every bullet fired from it; that the mark left by one weapon differs from that left by every other firearm in the world, and that nothing can be done by the most expert of gunsmiths to change the mark left by any gun without altering the caliber of the rifle, pistol or revolver, as the case may be.

Similarly, each gun leaves its special and particular mark on every cartridge shell ejected, a mark different from that made by any other firearm. Thus, when the discarded shell can be found at the scene of a crime, even though the bullet itself may be missing, the weapon can be identified. Then it is up to the police to find the owner. If both shell and bullet are obtained, there is a double check on the user of the gun.

The ejector on each make of firearm makes a different mark on the base of the discarded shell. Right: Base of a 45-caliber shell from an automatic pistol. By it the pistol was identified, its owner learned, and a murder mystery solved. The mark of ejector, as well as of firing pin, may be seen in the upper center of outer rim.

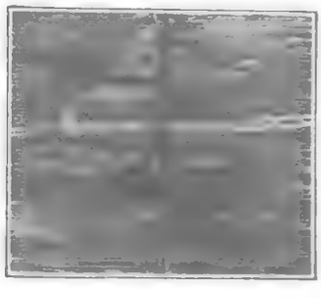
The development means not only that the Colt leaves a different gunprint from the Luger, the Winchester, the Browning, or any other make, but that each individual weapon of each company's make leaves a mark differing from that made by each and every other weapon produced by the same factory. As Richardson says:

"This method of 'finger-printing' firearms, which I have called 'gunprinting,' identifies a gun by the marks it leaves on the projectile it discharges just as accurately and as certainly as a criminal can be identified by the prints of his fingers on objects he handles.

"It has been known for a long time that, even when no weapon is available for examination, a study of the recovered bullet will reveal the caliber and the make of the weapon which fired it. This has enabled the police to center their efforts on locating a weapon of this size and manufacture. But it has always left the identification of the particular, individual weapon difficult, sometimes impossible. Many obvious criminals have escaped punishment by inability of the authorities to identify the weapon with which the crime was committed.

"With the development of the new science, however, it is possible to identify exactly the particular weapon which fired the bullet or ejected the empty cartridge. Possession of a weapon so identified goes far toward conviction of the man carrying it. Beyond this, it is now possible to trace 'wanted' to dishonest dealers in firearms, just as it is possible to trace crooks by

(*Continued on Page* 1157)



Here are two bullets; the identifying marks are the fine lines cut by the "lands" in barrels. "Land" marks differ in every gun.

GASOLINE ENGINE VERSUS SAND

MOTOR SHIPS

An unusual scene on the desert with the new motor ship carrying several hundred passengers in comfort and safety. A German engineer, Bishoff by name, is responsible for this latest means of desert transportation.

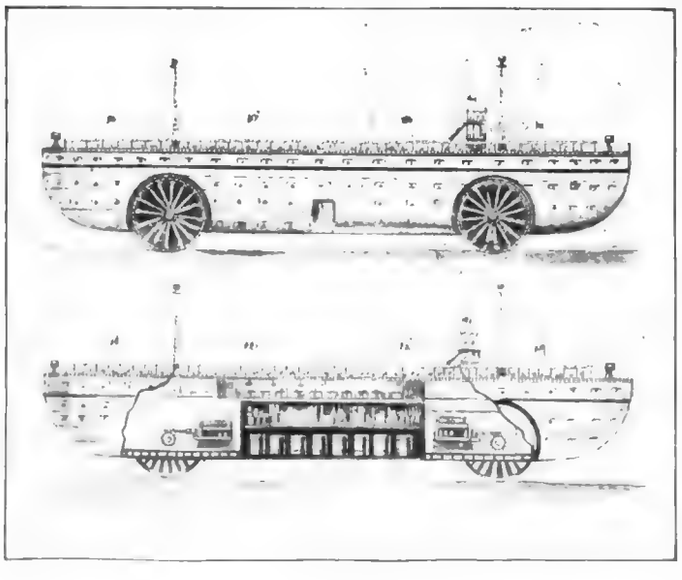
FOR æons people have traveled across the Sahara Desert on the back of a camel, the camel being a very important part of the setting for such a journey, owing to the fact that it can go for several days without a drink. The great problem in attempting to travel across the desert has been the lack of water and the terrific heat caused by the tropical sun beating down on the sand. In the past few years French engineers have succeeded in designing a suitable automobile for negotiating the desert routes, this automobile being illustrated in the picture on the opposite page, where we also see the famous camel taxi known as a Bussoura. The automobile, of which many are in use for desert travel today, represents one of the units of the French military transport service. The car is fitted with a tractor belt tread at the rear, this belt being driven by a gasoline engine. An extra large water cooling system is fitted to these engines. Referring to the Bussoura or camel taxi shown in the same photograph, this name comes from the tent-like basket or cabin fitted to the camel's back, and which provides protection against the hot desert sun for two passengers.

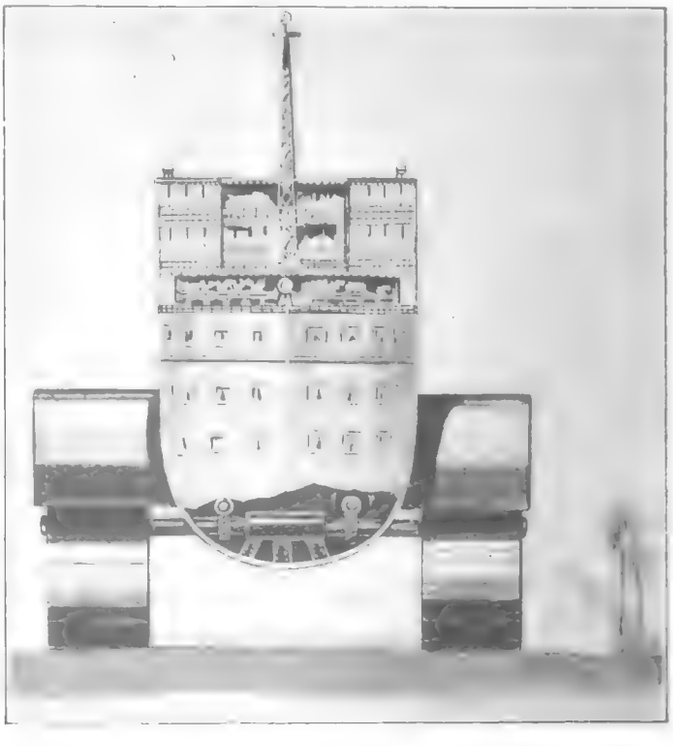
The feature which we wish to speak of here, however, is the new giant motor ship for desert transportation of passengers and freight, which is shown in the accompanying artist's picture, on its way across the desert at night. This strange land craft is the brainchild of a German inventor, one Johann Cristoph Bishoff, who is working out his ideas in conjunction with other engineers and with the cooperation of industrial interests. This future *ship of the desert* will have a capacity of 300 passengers and fifty tons or more of freight.

As the illustrations at the bottom of this page show, the craft greatly resembles an ocean liner mounted on huge wheels. Many of our readers will doubtless remember that back in July, 1917, during the World War, Mr. H. Gernsback published an article in this journal, then known as *The Electrical Experimenter*, entitled, "Old U. S. Battleships to the Front," as the cover of that issue of the magazine reproduced on the opposite page shows. Mr. Gernsback's idea at that time was that we should take some of our old battleships, cruisers, etc., steam them across the ocean under their own power, and then fit them out with the steel girder wheels as illustrated, so as to form huge battle tanks. It is quite possible that the idea published at that time provided the spark of genius behind the newly devised desert motor-ship. This ship of the desert will make twenty miles an hour and better under ordinary conditions, and a speed of at least ten miles an hour if the sand is soft and deep.

The end view of the new motor ship for desert transportation of passengers and freight, shown at the right, reveals how the huge gasoline engines drive the wide tread wheels by means of worm gears. ➤➤➤

The picture below shows external side view as well as semi-sectional view of the new motor ship of the desert designed by a German engineer. The desert ship is 300 ft. long, 38 ft. in breadth, and stands 50 ft. high, the wheels being about 40 ft. in diameter. Capacity 300 persons and 50 tons freight.

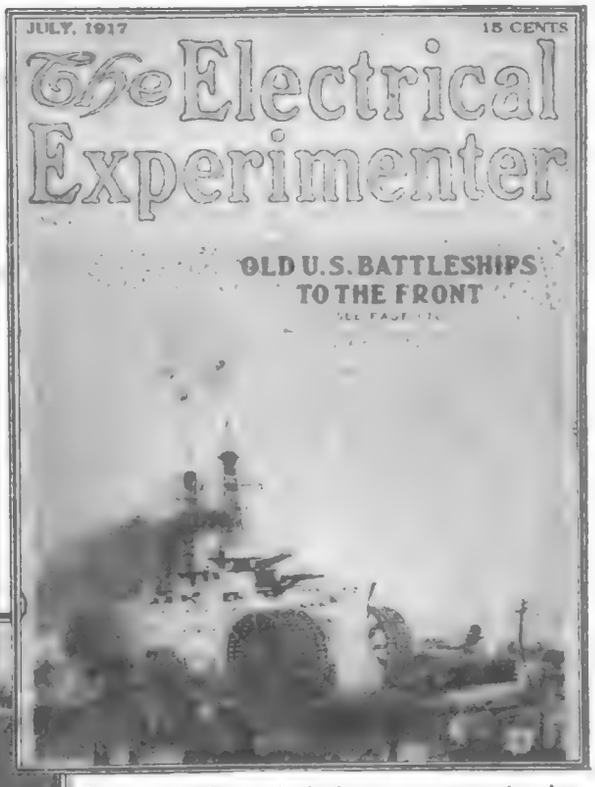




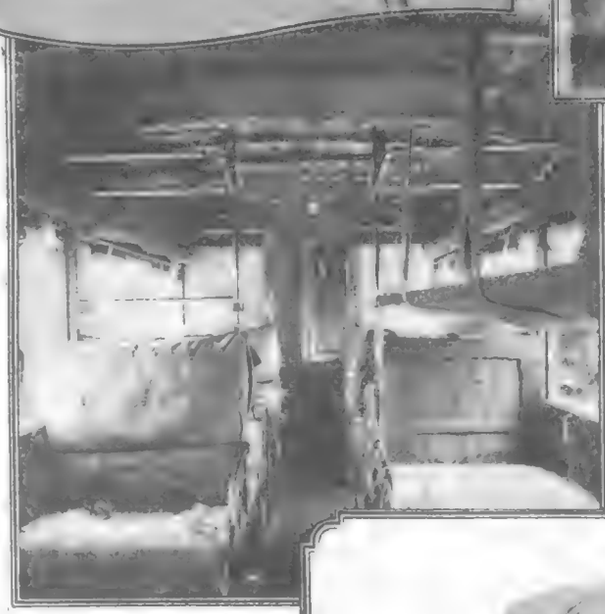
OF THE DESERT

SANDY DESERT LOSES TERROR

The old camel taxi with its enclosed cabin for two passengers is shown above in marked contrast with the special automobile having a tractor drive, many of which now cross the desert regularly.



Ships to travel over the land are not so new, for above we see that this journal, then known as "The Electrical Experimenter," back in July, 1917, advocated putting wheels on old battleships to provide huge "tanks" to smash the enemy lines and fortifications.



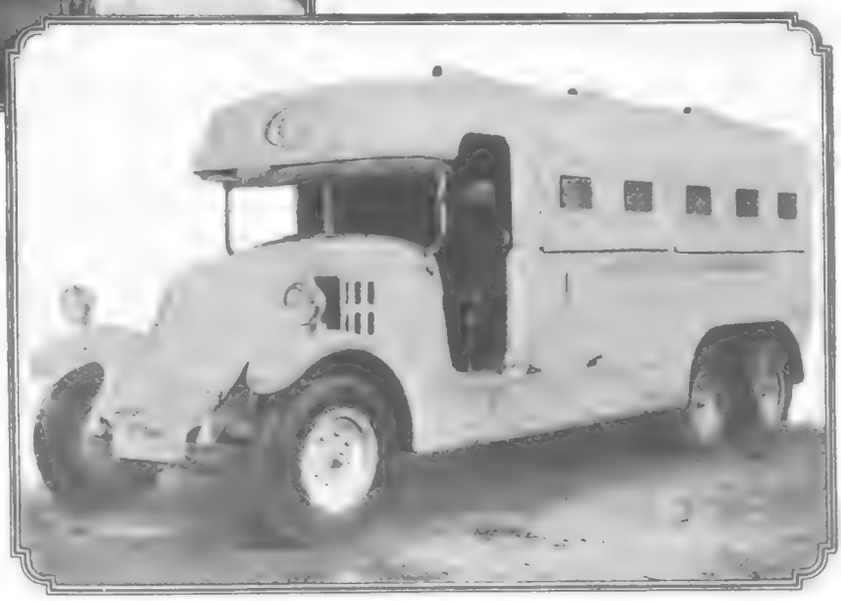
Above we see interior of new Sahara Desert bus, the seats forming beds at night.

THE pictures on the opposite page show the latest and largest motorized method of transport for both passengers and freight over desert regions, such as the Sahara. The pictures on the present page are very interesting also as they show how special automobiles have been devised by French engineers so as to be suitable for traveling at fair speed over the burning sands of the desert. Sand storms on the desert are one of the factors which has to be conjured with, and the motor ship and the motor bus represent a distinct advance in desert transportation means for this reason particularly. The windows can be closed and the passengers as well as the driver thus protected against the swirling sands, which have spelled death to more than one traveler. These sand storms spell ruin to any ordinary automobile engine not fitted with a sand filter or screen. Thanks to the new sand and dust filters brought out in the past few years for attachment to the intake pipe of the carburetor, it is now possible for motor cars to travel over such treacherous sandy wastes as the Sahara Desert, without ruining the engine after a relatively short time.

Up until recently it took many days to cross the Sahara Desert on camel back, and aside from possible hold-ups by brigands, there was always the discomfort due to the burning heat of the tropic sun beating down on the sand. There was also the menace of desert sand storms, not to mention the boresome conditions occasioned by the slow speed of the camel transport and many other factors.

Not only is radio and the gasoline engine, not to mention the possible adaptation of the Diesel engine, revolutionizing desert travel, but due to the improvement in the traveling conditions and the speed, a trip across the desert may conceivably become a quite inviting proposition instead of a journey filled with dread and fear.

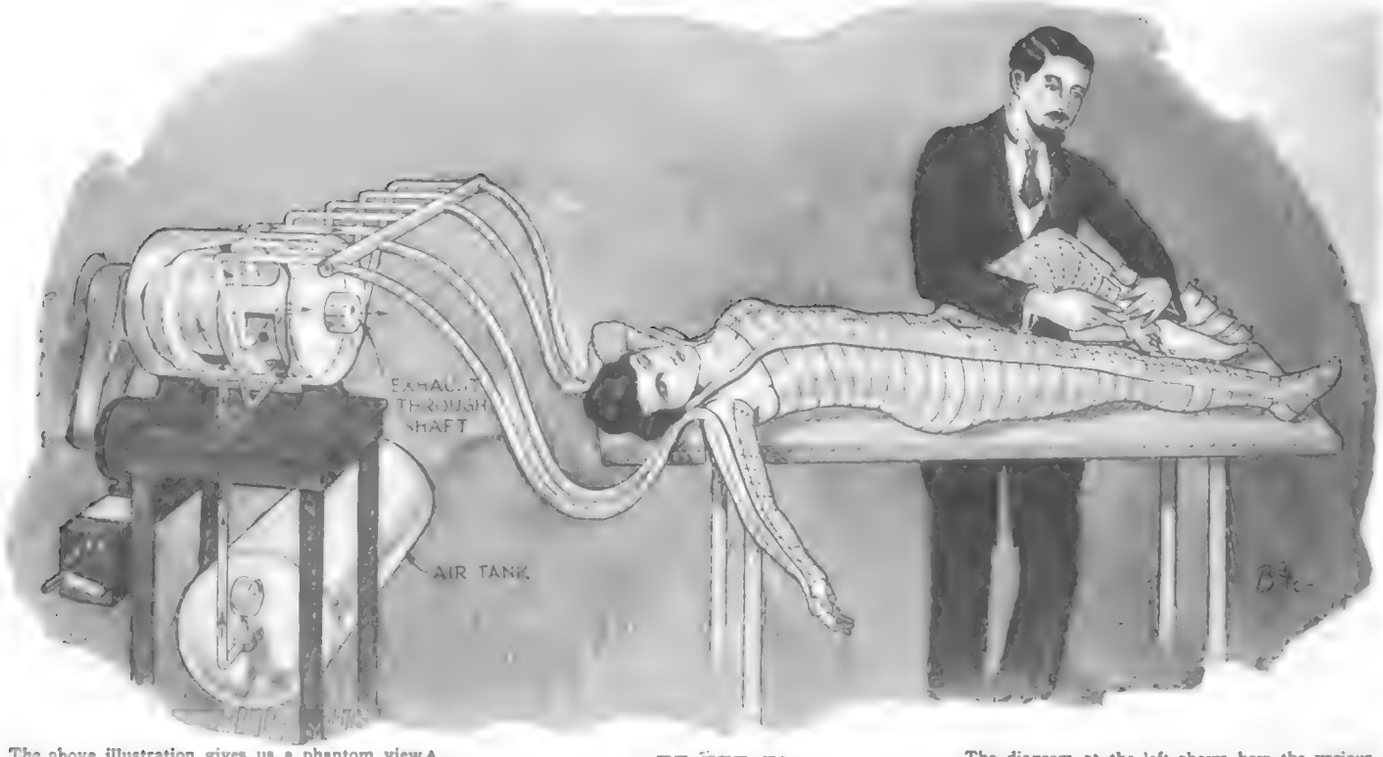
The two photos occupying the lower part of this page shows one of the latest developments of the famous French automobile concern bearing the well-known name of Renault. It will be possible now with these motor transports to shorten the time of making a trip across the Sahara Desert to at least one-tenth that previously occupied in making the trip by camel back. Extra supplies of water and gasoline are carried in the motor bus as well as in the French military automobiles, shown in the top picture; while a special grade of oil is also utilized, this oil being of a heavy quality.



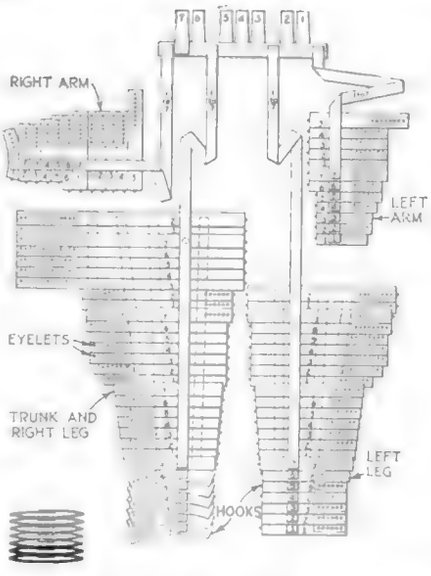
Giant auto car sleeper for trans-Saharian service. It accommodates eight passengers and seats can be converted into beds. The bus is fitted with every modern convenience, including drinking water. Instead of a tractor drive this car is fitted with twin rear wheels.

Pneumatic Suit Aids Heart

By JOSEPH H. KRAUS

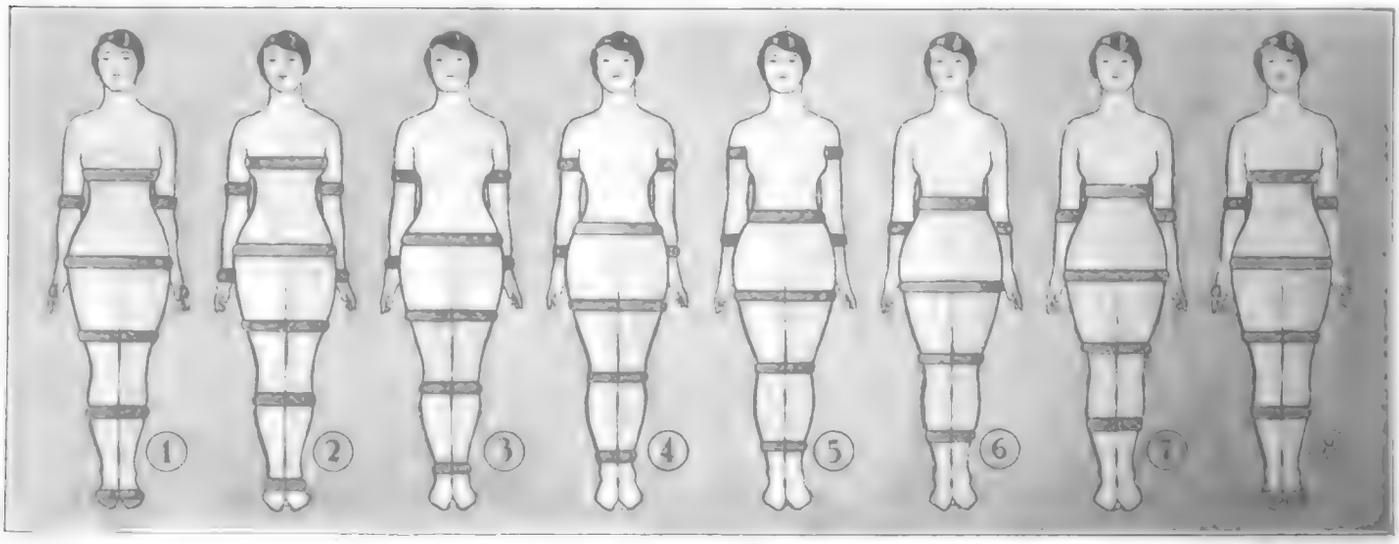


The above illustration gives us a phantom view through the mechanism which operates the sections of the pneumatic suit primarily intended to relieve the work of the heart.

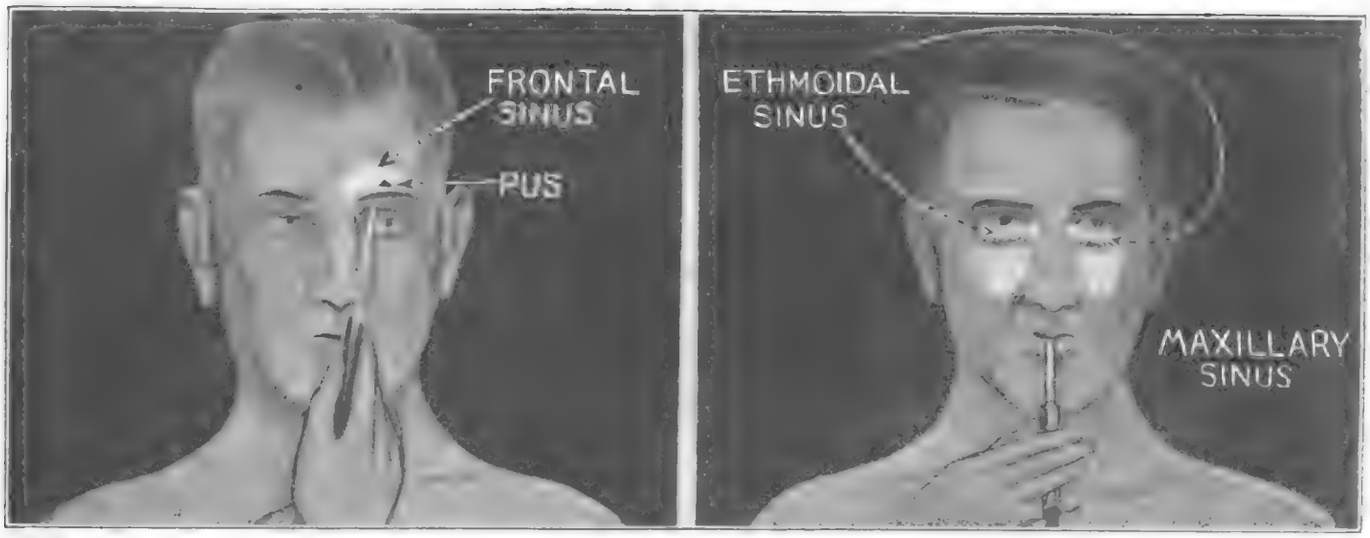


The diagram at the left shows how the various sections of the suit are tied together. Each band has seven tubes and the respective numbers are all inflated at the same time.

IN the illustrations on this page we find a very clever therapeutic device primarily intended to assist in the circulation of the blood and also serving to massage the human body. The inventor, Joshua Rosett, of New York, believes that this type of pneumatic suit will provide relief to a certain extent for the work of the heart where such relief is necessary. This is accomplished by propelling the venous blood at the surface of the body from the limbs and from the trunk toward the heart. By the accompanying kneading of the muscles and tissues, the circulation of the deeper fluids of the body such as the blood in the inner veins and the lymph in the lymphatic spaces is consequently enhanced. Generally speaking the device consists of what may be considered a pneumatic suit or garment adapted to be applied to the trunk or limbs of a patient. This suit is made up of collapsible tubes to which air under pressure may be admitted in such a manner as to inflate the tubes one after the other in successive groups, so as to cause the garment to exert waves of pressure from the extremities of the limbs and from the lower portion of the trunk of the patient towards the region of the heart. The compressed air is admitted from an air tank to a distributor which respectively passes the air into any one group of seven tubes each in successive order. Each unit of the garment is represented by seven tubes evenly spaced so as to form distinct hose-units. For convenience in handling, the garment is so arranged that it may be quickly snapped around the body and the limbs. The tubes themselves are made of an air-tight textile fabric such as rubberized silk or cotton. Referring to the picture above, we see a patient having suit adjusted.



The diagrams above show how the various portions of the body are affected by the inflated bands. First the tubes indicated in Fig. 1 are inflated. Then the air passes out of these to enter the tubes as indicated in 2 and so on the stages progress, until in stage 8, a repetition of the movement started at 1 reoccurs. By passing the eye across the page quickly, one can see the wave-line motion which will be produced.



A new system of examining the sinuses, those very important head cavities which sometimes become diseased and cause a lot of trouble, is here shown. The sinuses are made visible by a powerful concentrated electric light held against the skin immediately under the eyebrow, right and left alternately.

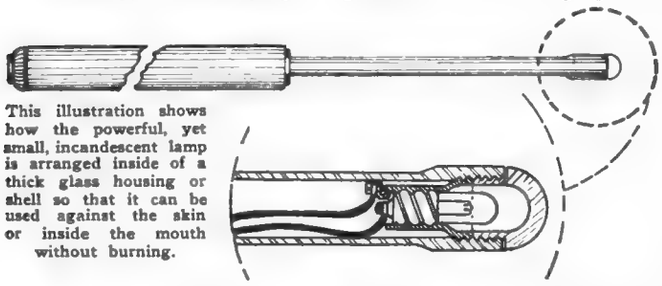
By holding the small, yet powerful, light in the mouth, the Maxillary Sin uses light up in a dark room, and the physician can immediately tell whether there is any pus present, which would indicate a diseased condition of the Sinus. The Ethmoidal Sinuses are also examined in this way.

Are Your Tonsils and Sinuses Healthy?

By H. W. TOWNSEND

Modern Science Aids Diagnostician to Tell Exact Condition of Sinuses and Tonsils

THE physical condition of the tonsils and the all-important sinuses, up until recently, have been judged a great deal by their appearance, at least in the case of the tonsils. The average doctor looked down the patient's throat and if he saw no inflammation and if the tonsils were not enlarged, he was quite likely to decide, naturally enough, that the patient was in good healthy condition. We now know, according to medical science, that infected tonsils are liable to cause Bright's disease or rheumatism. Recent experiments made by the famous Mayo brothers with Guinea pigs and rabbits, which were innoculated with the poisonous pus from diseased tonsils, showed that in practically 100 per cent. of the cases either severe rheumatism occurred, or else eventually Bright's disease appeared.

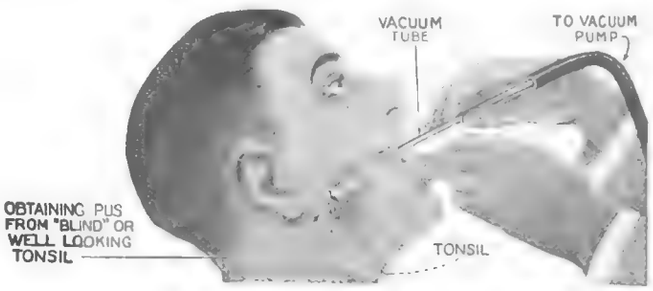


This illustration shows how the powerful, yet small, incandescent lamp is arranged inside of a thick glass housing or shell so that it can be used against the skin or inside the mouth without burning.

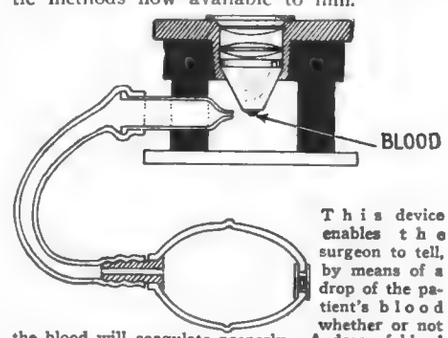
These serious ailments are often caused by diseased tonsils, due to the fact that the poisonous pus given off by the tonsils drains away into the blood stream and innoculates the whole body. People who feel greatly fatigued early in the day are often victims of diseased tonsils, the poisonous secretions from the tonsils affecting their whole bodily state of health.

Another peculiarity of diseased tonsils is that they may cause a chronic or nearly chronic inflammation of the throat and nasal membrane, which is hard to diagnose from the ordinary observation, by simply looking into the patient's mouth and throat. The average physician will probably think that the patient has had a severe cold and prescribe a gargle or nose and throat spray. The inflammation of the throat lining may temporarily disappear with this treatment and appear to be cured, but if the tonsils are diseased, they will cause further frequent re-occurrences of the inflammatory trouble. They also cause the patient to have frequent colds in the head, due to the slightly inflamed condition which is always more or less present in the throat in such cases. Such conditions also affect the feeling of the patient in general and he is liable to have a slight cough, and, moreover, will tire easily from talking or singing.

It was thought at one time that the removal of the tonsils, where they happened to be diseased, affected the voice, but it is now believed that such is rarely the case and that one of the most important factors which determines the quality and strength of the voice is the physical condition of the sinuses, those important cavities in the front of the skull immediately below and above the eyes, as the pictures at the top of the page show. The physician or surgeon diagnosing sinus ailments has new diagnostic methods now available to him.



Tonsils frequently look very healthy when observed with the naked eye. The throat specialist, however, makes doubly sure as to whether the tonsils are diseased and contain pus or not, by applying, for a few seconds, a warmed glass tube connected with a vacuum pump; the suction causes a sample of the pus, if present, to be drawn from the tonsil.



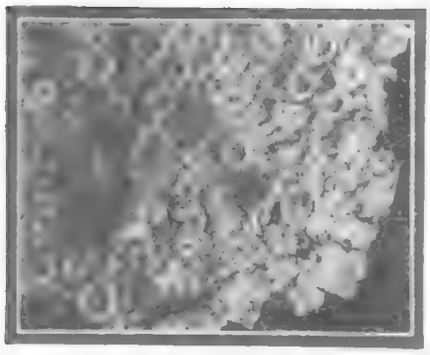
This device enables the surgeon to tell, by means of a drop of the patient's blood whether or not the blood will coagulate properly. A drop of blood is placed on the glass prism; it must show coagulation in a certain time when air from the bulb is blown against it.

The writer recently underwent an examination by a well-known throat specialist, and the method of examination the latter utilizes is that here illustrated, where a new and powerful diagnosing lamp is pressed against the skin just under the eyebrow, first right and then left, to light up the frontal sinuses. The presence of any pus in these sinus chambers is indicated by a dark shadow or spot. The patient next holds the light in his mouth and closes his lips over the stem of the lamp, when the Ethmoidal and Maxillary sinuses just below the eye, become illuminated by the light shining through from the inside of the head. By means of a mirror patient can see sinuses also. Another new method of examining sinuses is that in which an assistant strikes a large tuning fork on a table, causing it to give forth its own particular note; while the tuning fork is vibrating, she holds it on the top center of the patient's head. The sound waves from the tuning fork are carried by the bony structure of the skull and naturally the sinuses, which are nothing but

(*Continued* [illegible])

Protective Coloring in Insect Life

By HERBERT C. McKAY, A. R. P. S.



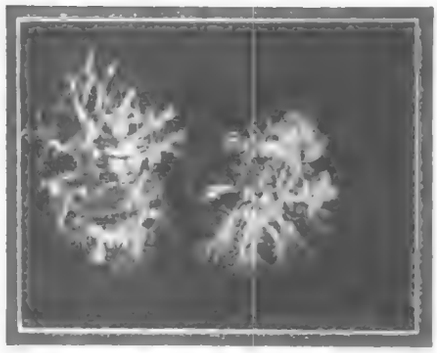
A vividly colored group of small beetles and flies which live on the lichens of orange trees, easily seen except when placed upon a lichen as indicated in the photo above. Only the sharpest eyes can pick them out.

WHEN we see a woman wearing a leopard-skin coat upon the street, we may admire the design and coloring, which appears so brilliant in the sordid dun-gray of the city background, but we seldom stop to think that in the jungle this brilliant coat is practically invisible.

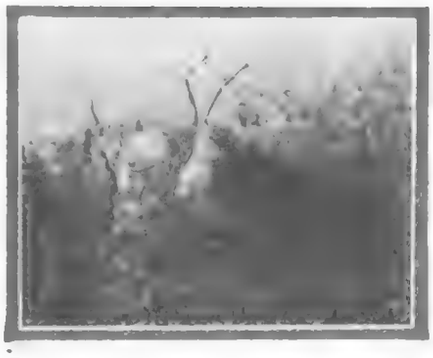
Much has been said on both sides concerning protective coloration in the animal world. But whether it be admitted that such coloration is a result of selection or purely accidental, there is no doubt but that it does exist. Perhaps there are no more striking examples of this phenomenon than those found in the insect world.

The modern man, even slightly interested in science, is somewhat familiar with microscopic organisms, and naturally we all know the objects of every-day life, but very few persons indeed have had the pleasure of observing the inhabitants of the middle-ground. Here we find a new universe. The animal life is highly organized as in the usual gross animals, and so is more interesting to the layman than the simple forms which constitute the usual microscopic world. At the same time these forms are so small that while they are visible as a whole, details of their anatomy is seen only by the aid of a moderate-power glass. In this world we find some striking examples of protective coloration.

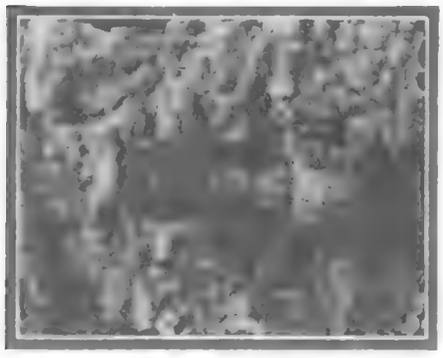
The grape beetle can be quickly seen when placed upon a white background. The same grape beetle is hardly more than barely noticeable when placed upon a grape vine bark as the photo below shows.



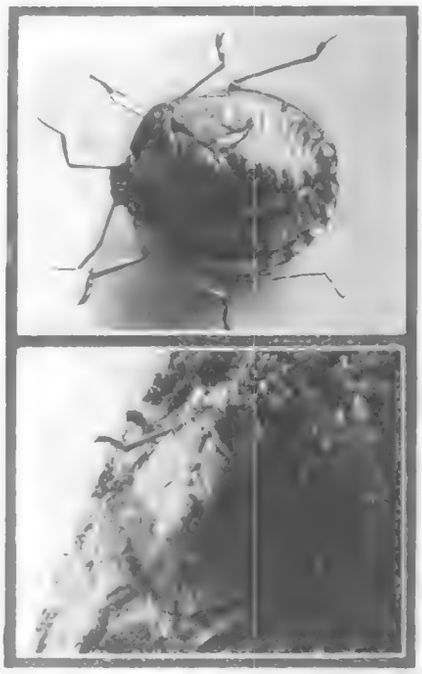
Above, lichen louse which infests orange trees as it never appears in nature. Left, the insect encased in its web and hardly visible.



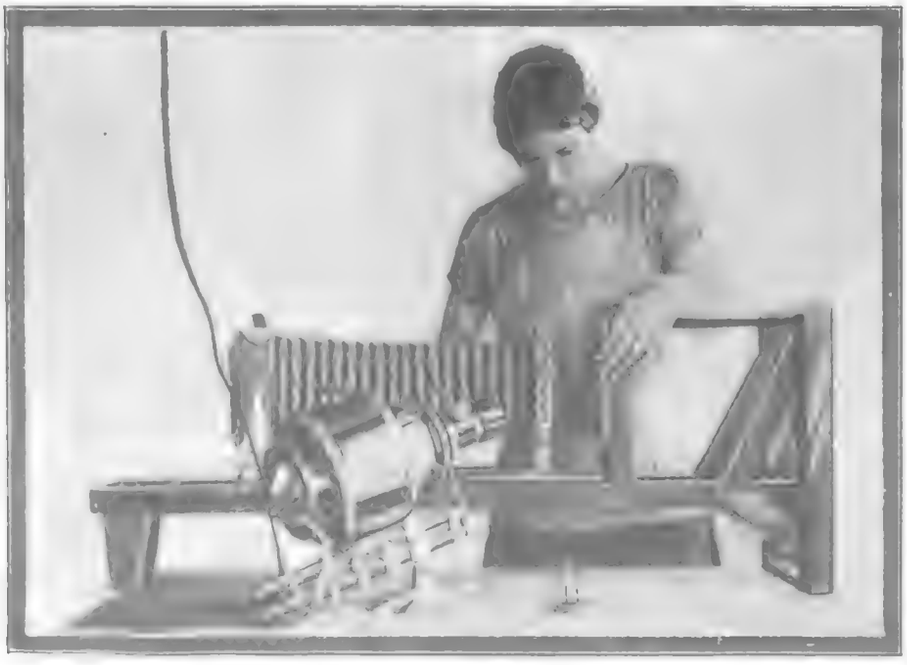
The mantis at home. Here the insect is shown upon the lichen where it feeds in its natural life. Due to the enlargement, and the monochromatic rendition of the camera, it is here more easily seen than in nature. Most people cannot see the insect even when it is pointed out to them. Photo below shows it as it appears when placed on white background.



This form of defense is found in two phases. In the first we have that coloration and form which makes the insect inconspicuous, but does not fully disguise it. This is usually accompanied by coloration which will enable the insect to blend more or less perfectly with its background. In this class fall the small beetle shown as well as the pumpkin-bug (Nezara viridula). These are shown about six times natural size. The beetle is a dark reddish brown with irregular light gray markings. This is the usual appearance of the woody stems of the grape-vines upon which this insect lives. The pumpkin-bug, on the contrary is of a light green tone, with brown, yellow and dark



The pumpkin bug is easily seen when removed from his natural haunts, but when placed upon a green lichen, the color of the bug blends with that of the plant. This is an example of inconspicuous coloration. Left—the apparatus with which these photographs were taken.

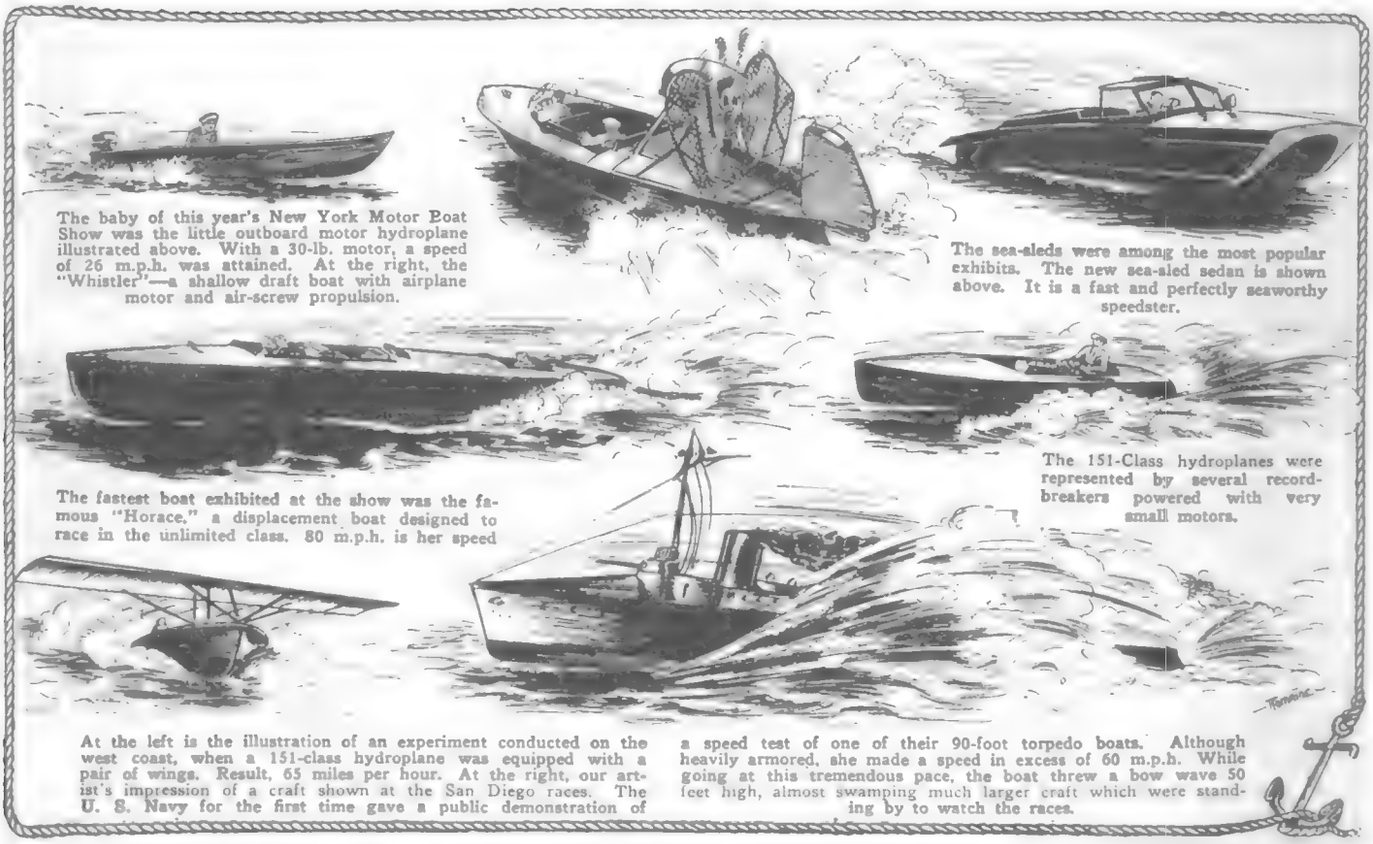


(*Continued on page* 1155)

Auto Show Presents New Features

The automobile show held at Grand Central Palace in New York City during the first week in January, introduced a number of new ideas and devices to the motoring public. Some of the most interesting of these innovations are illustrated on the borders of this page. Fig. 1 shows a hood protector which prevents rattling and protects the engine from extreme cold weather. Fig. 2 is an anchored gas tank cap, to prevent loss. Fig. 3 shows a method of thinning the transmission oil by adding a special liquid which lightens the consistency of the lubricating fluid. The Ford owner will appreciate the device illustrated in Fig. 4, which is a damper disc to prevent the front wheels from shimmying. Fig. 5 shows one of the new fabric bodies, which are so flexible that they may be bent by a slight pressure: They return immediately to their normal shape. Fig. 6 illustrates a thermostatic switch which doubles the charging rate of the dynamo in cold weather, to make up for excessive drain on the battery. Fig. 7 is an automatic windshield cleaner which travels the full width of the windshield, giving the driver an unimpeded view of the road. Fig. 8 is a cotter pin which automatically locks itself into place upon being driven into a hole. It is unlocked by twisting slightly, as shown. A combination gauge which affords an excellent check up on the condition of the motor is illustrated in Fig. 9. Fig. 10 is a clever arrangement for reflecting part of the beam of the headlight backwards, so that the driver may easily tell whether both lights are burning without getting out of the car. Fig. 11 illustrates a spotlight which is designed for use on enclosed automobiles, and which is fully controllable in all directions by a handle within the driving compartment of the car. Fig. 12 shows an anti-stalling device, which automatically turns on the electrical starter when the dynamo voltage falls. Figs. 13, 14, and 15 explain themselves. Fig. 16 tests the condition of the valves as to leaks. At the top of this column are shown the comparative sizes of the largest and smallest cars entered in this show. A man could look over the top of the small car.

Speed at the Motor Boat Show



The baby of this year's New York Motor Boat Show was the little outboard motor hydroplane illustrated above. With a 30-lb. motor, a speed of 26 m.p.h. was attained. At the right, the "Whistler"—a shallow draft boat with airplane motor and air-screw propulsion.

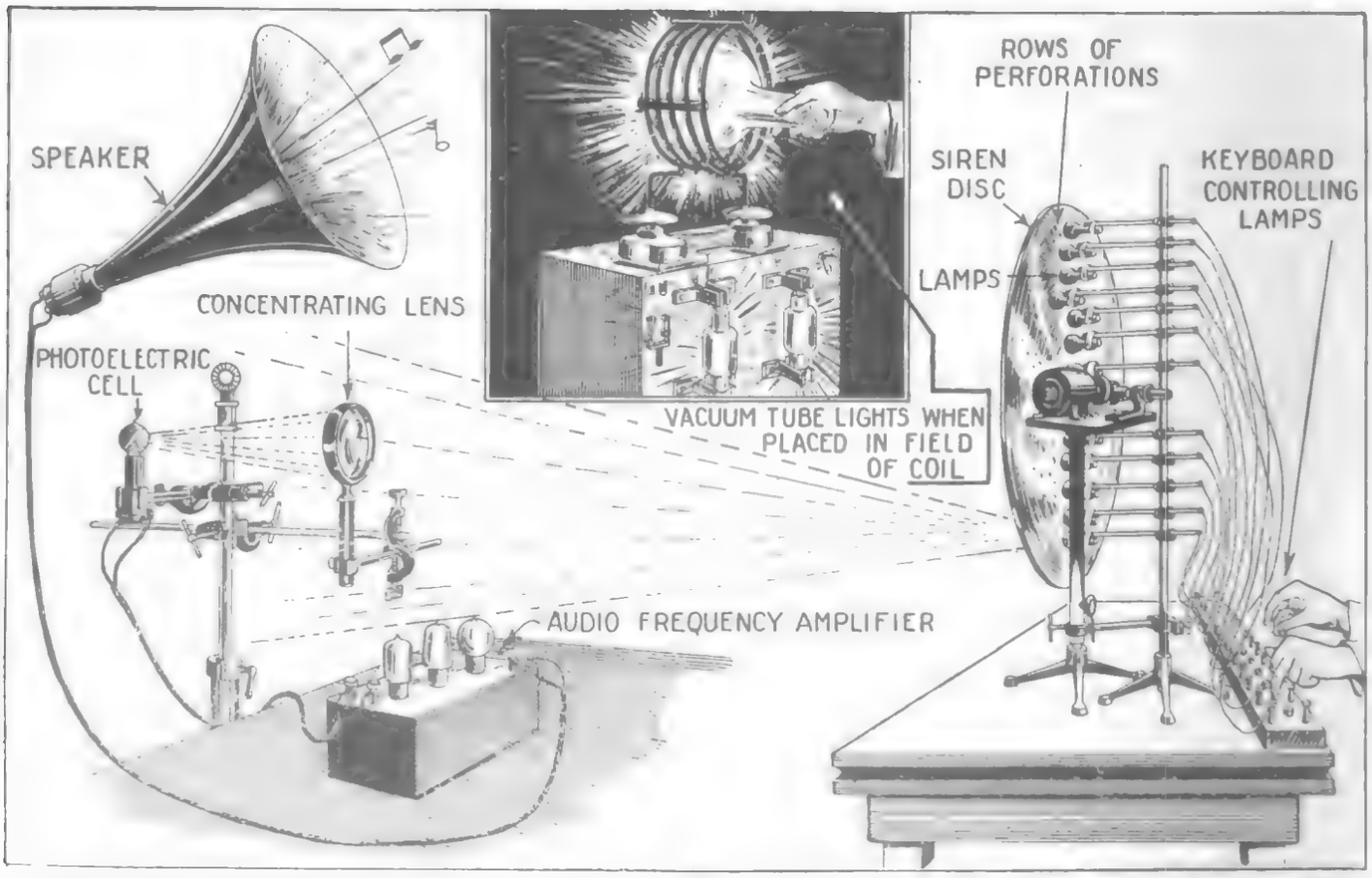
The sea-sleds were among the most popular exhibits. The new sea-sled sedan is shown above. It is a fast and perfectly seaworthy speedster.

The fastest boat exhibited at the show was the famous "Horace," a displacement boat designed to race in the unlimited class. 80 m.p.h. is her speed

The 151-Class hydroplanes were represented by several record-breakers powered with very small motors.

At the left is the illustration of an experiment conducted on the west coast, when a 151-class hydroplane was equipped with a pair of wings. Result, 65 miles per hour. At the right, our artist's impression of a craft shown at the San Diego races. The U. S. Navy for the first time gave a public demonstration of a speed test of one of their 90-foot torpedo boats. Although heavily armored, she made a speed in excess of 60 m.p.h. While going at this tremendous pace, the boat threw a bow wave 50 feet high, almost swamping much larger craft which were standing by to watch the races.

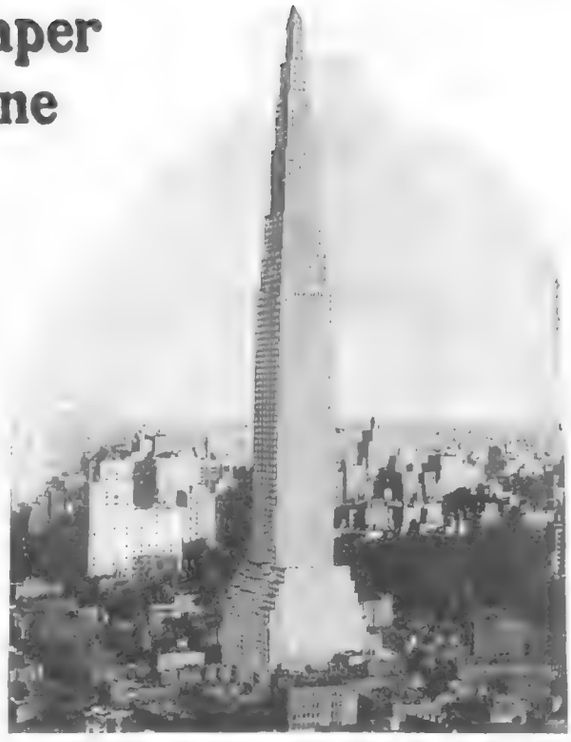
Two Scientific Marvels of the Year



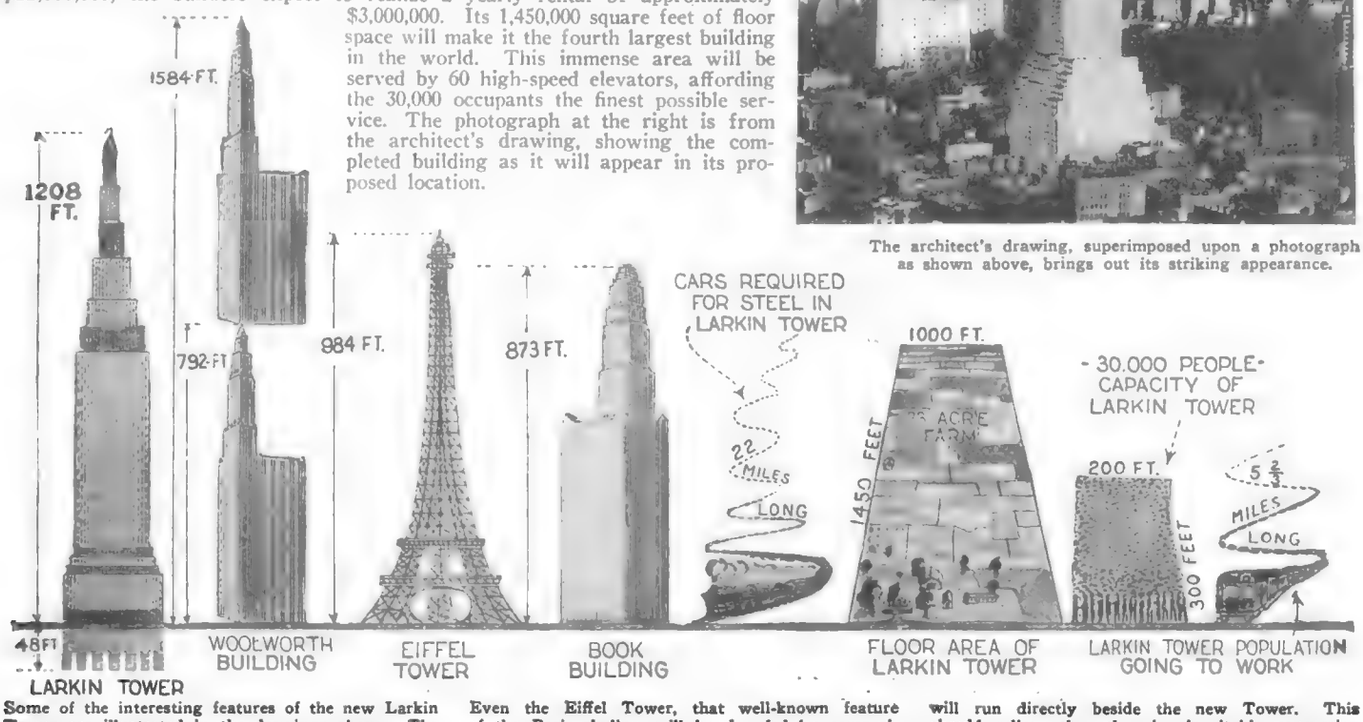
Dr. E. E. Free gave an interesting lecture recently at the New York Electrical Society, in which he described the Light-ray Piano, and the Wireless Light shown above. The operation of the "piano" is obvious from an inspection of the drawing. The "wireless light" consists of a large solenoid of copper strip, which is energized with high-frequency A.C. from the output of two 250-Watt vacuum tubes. Into the field of this solenoid is inserted a gas-filled "vacuum" tube, and the molecular acceleration in the gas causes a strong light to be emitted by the tube.

110-Story Uptown Skyscraper to Top New York's Skyline

FOR a number of years, the Woolworth Building has enjoyed the distinction of being the tallest business structure in the world. But it has suffered a double eclipse in the past year, first when the Book Building in Detroit was announced with its height of 873 feet, and again when a real super-skyscraper was proposed in New York City. This latest project is peculiarly interesting, less because of its extreme height than because of its history. The fact is that the building was not specially designed to be taller than other buildings. The architects simply endeavored to provide the greatest amount of permanent light and air to the greatest possible proportion of floor area, with a surplus of elevator service. The projected building came naturally out of these conditions. The architectural aspect of the structure is featured by its severely simple lines, approaching an ideal of skyscraper construction. The building, called the Larkin Tower, will front 226 feet on the south side of 42nd Street, 300 feet west of 8th Avenue, and run through the block to a frontage of 250 feet on 41st Street. The height of the building from the ground to the base of the flagpole is to be 1208 feet. From a first cost of $22,500,000, the builders expect to realize a yearly rental of approximately $3,000,000. Its 1,450,000 square feet of floor space will make it the fourth largest building in the world. This immense area will be served by 60 high-speed elevators, affording the 30,000 occupants the finest possible service. The photograph at the right is from the architect's drawing, showing the completed building as it will appear in its proposed location.

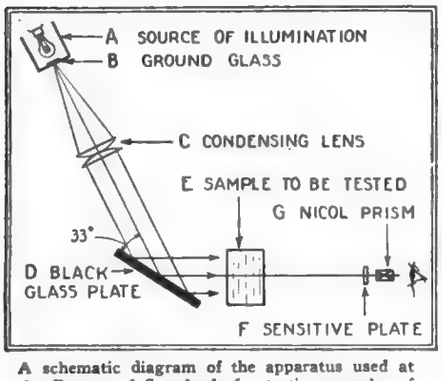


The architect's drawing, superimposed upon a photograph as shown above, brings out its striking appearance.



Some of the interesting features of the new Larkin Tower are illustrated in the drawings above. The famous Woolworth Building will be "just another skyscraper" after the uptown giant is completed. Even the Eiffel Tower, that well-known feature of the Paris skyline, will be dwarfed by comparison with the Tower's 1,208 feet of height. A new subway is being built under Eighth Avenue, which will run directly beside the new Tower. This should relieve the otherwise inevitable congestion which would result from the presence of a building of this character in this neighborhood.

Testing Glass Products for Strain



A schematic diagram of the apparatus used at the Bureau of Standards for testing samples of commercially produced glassware for strain.

A piece of suspected glass is placed in the beam of light between the polarizing plate (D) and the Nicol prism (G). Parts of the glass will seem colored differently than the original field. If well-annealed glass is examined, practically no change in color will be seen, and if a highly strained piece of glass is used, the colors in striations will be vivid. If the sensitive tint plate (F) is removed, and three differently strained pieces of glass are examined, the first (moderate strain) will appear brighter in certain areas, the second (no strain) will produce no change, and the third (high strain) will be very bright, or even colored in some places. This process has been applied commercially to the testing of glass products such as jars and bottles in industrial use.

The engineer shown in the photograph above is demonstrating the the Strain Detector in testing storage battery cells.

Famous Inventors I Have Interviewed*

By H. WINFIELD SECOR

DR. NIKOLA TESLA

ANYONE connected with journalistic work will usually come in contact with inventors and men of science at sometime or other in their career. It has been the speaker's good fortune at various times to interview and become acquainted with some of our leading electrical and radio inventors. The first inventor I shall introduce to you to-night is *Dr. Nikola Tesla.* Nikola Tesla is a Serbian by birth and was educated in the best schools and universities of Europe. Dr. Tesla has lived in this country for thirty years or more, and Americans have doubtless come to the offhand conclusion that he is an American by birth.

Several years ago SCIENCE AND INVENTION Magazine published a series of articles entitled, "My Inventions," which were prepared by the famous Tesla, and it was at that time the speaker had a good opportunity to become quite well acquainted with this master mind in the field of electrical and radio invention.

Doubtless those who have heard of the many inventions of Tesla have thought that his ideas have been mostly along the line of electrical and radio subjects. However, he is a *mechanical engineer.* It was through his deep insight into the subjects which mechanical engineers study, that he brought forth his first, and what many people consider his greatest invention—namely, the induction motor, which the Westinghouse people first placed on the market.

Dr. Tesla not only thought out the remarkably simple idea involved in the induction motor, which is in use today by the thousands for driving machinery in our shops and factories, but he also went much further. He evolved the idea of the complete alternating current transmission system, with transformers for stepping up the voltage and again reducing it at the consumer's end of the line

Tesla came to this country at about the time Thomas A. Edison was installing his first electric light plant in New York City, and he was associated with Mr. Edison for a short time at that period.

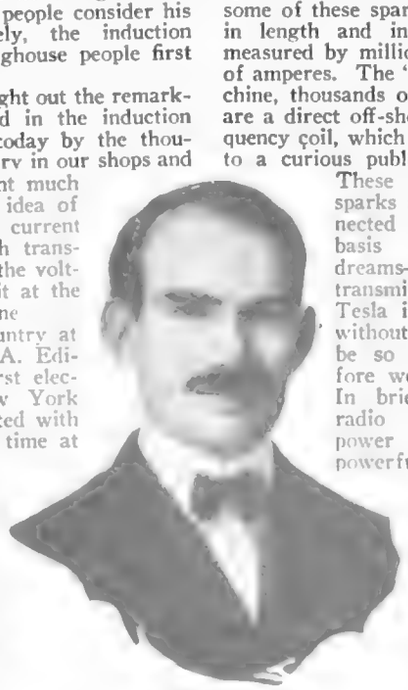
It has been said of this great genius, Tesla, that he is one hundred years ahead of his time. The more one becomes acquainted with him and learns of his many ideas, dozens of which he has had recorded in patent applications standing for a number of years, the more one becomes convinced that he is a man of tremendous intelligence and far-reaching vision.

Just to give you a slight idea of the clever way in which Tesla brings together a number of ideas, and out of which he evolves a single new idea of superior merit, the speaker might mention Tesla's prediction in regard to the outcome of the late World War. About the time we went into the conflict, the speaker asked Dr. Tesla, who he thought would win the War and why. His prediction was that the Allies, with the aid of the United States, would be successful in winning the War, and his reasons given at that time, were remarkable for their clearness of thought and logic.

Tesla, whose name is known around the world, has patented dozens of electrical radio and mechanical inventions, from which of course he has received thousands of dollars in royalties. He is a man who has devoted the best part of his life to invention and thought on scientific subjects. Dr. Tesla is a bachelor, and while he likes luxurious surroundings and fine foods, he has a number of deep founded ideas in regard to his daily life which are well worth duplicating. He has not smoked for twenty years, he once stated at a luncheon, although he delights in seeing his friends enjoy a fine cigar. When he orders a meal, he believes in selecting a few dishes of substantial food in preference to a lot of fancy dishes. Dr. Tesla, who lived for many years at the Waldorf Astoria hotel, and who dined at Delmonico's and other famous New York restaurants, conceived a number of delightful dishes, several of which bear his name. So we see that he is a man *of many parts,* as the saying goes, and has not confined his inventive genius to the mechanical and electrical laboratory.

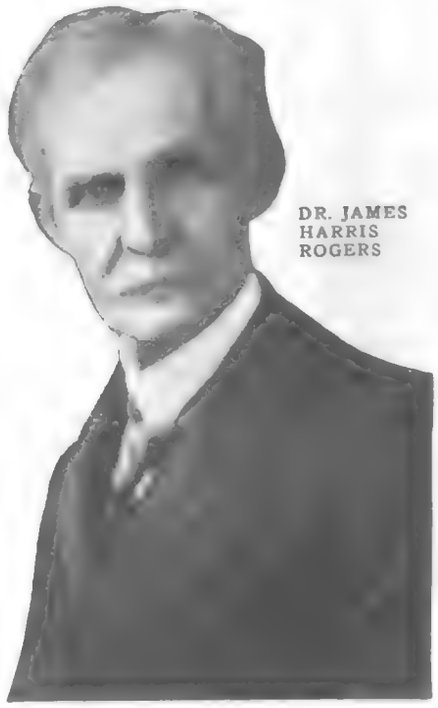
Tesla, as every electrical student knows, produced many years ago out in his Colorado laboratory the greatest high frequency, high voltage electrical discharges ever beheld by man.

Dr. Tesla's office walls are covered with large photographs showing the tremendous sparks produced in his laboratory years ago, some of these sparks having been many feet in length and involving electrical energy measured by millions of volts and hundreds of amperes. The "so-called" Violet Ray machine, thousands of which are in use today, are a direct off-shoot of the Tesla high frequency coil, which he built and demonstrated to a curious public over thirty years ago. These gigantic high frequency sparks and the experiments connected with them, formed the basis of Tesla's dream of dreams— namely, the wireless transmission of electrical power. Tesla is the father of this idea without a doubt, and it will not be so many years perhaps before we see his dream realized. In brief, Tesla's idea of the radio transmission of useful power is to use an ultra-powerful transmitter similar to a broadcast station. All you have to do in order to pick up useful power and operate motors, or light lamps, is to erect a capacity, such as an antenna, and absorb the desired energy from the electrical force radiating from the transmitting station.



DR. LEE de FOREST

Among other inventors and engineers whom the speaker has interviewed for the columns of SCIENCE AND INVENTION Magazine, he remembers with pleasure a visit during the hectic War days to the radio laboratory of Dr. James Harris Rogers, located at Hyattsville, Maryland, just outside Washington, D. C. Dr. Rogers is a courteous southern gentleman of the old school, who makes you feel at home as soon as you come into his presence. Dr. Rogers is internationally known among radio men for his invention of the underground antenna, for both transmission and reception of radio messages. When the speaker visited Dr. Rogers' laboratory in 1918, he experienced the unusual novelty of hearing the great radio stations in Rome, Nauen, Stavanger, and other points in Europe and some in South America received



DR. JAMES HARRIS ROGERS

by a single vacuum tube detector, with the underground antenna. Long ditches had been dug radially like the ribs of an umbrella, all over the Rogers' estate, and in these ditches in the ground he had buried various kinds of wire, both bare and insulated. The insulated wires used at the time the speaker visited the laboratory were enclosed in iron pipes and buried about three feet in the ground. The free ends of the antenna pointed east and west, but Dr. Rogers had others which he could connect to.

Dr. Rogers had a long legal fight with the Government experts as it seemed for a time that two radio engineers connected with the Navy Department had thought of the underground and undersea radio system, prior to its invention by Dr. Rogers. Before the advent of the Rogers system of intercepting the radio waves by means of an antenna buried in the ground or lying under water it was impossible for a submerged submarine to pick up radio messages at all. A submarine can now sink and still pick up radio waves from stations thousands of miles away, as actual tests have shown. This clever inventor had bethought himself also to try out transmitting on an underground antenna, and sent out messages, which were picked up

(*Continued on page* 1158)

*Radio Talk Delivered at WRNY, Tuesday evening, Jan. 18, 1927, 7:45 p.m.

Utilizing Ocean's Temperature for Power

French Scientist Shows How the Warm and Cold Waters in the Ocean Can Be Employed to Make Steam and Operate Vast Engines

IN July, 1923, SCIENCE AND INVENTION Magazine described a power plant which was intended to use the differences of temperature of sea water for creating steam and which employed the steam to drive immense turbines. The turbines were then to be connected to dynamos and develop electrical power or they were to be used for any other desired power purpose.

At the present time many reports are being circulated concerning the researches of Prof. Georges Claude, undoubtedly the greatest living authority on the liquefaction of gases, and P. Boucherot, who demonstrated before the French Academy of Sciences almost primitive appliances for utilizing the temperatures of the water of the ocean at various levels for operating a turbine. By means of a simple piece of apparatus in which a difference in temperatures of 20° Centigrade (68° Fahrenheit) was obtained, steam was generated and this steam drove a turbine for a mumber of minutes. The illustration at the lower right-hand corner shows the elements of the apparatus. Let us imagine that there are two flasks, one containing water and the other empty, and these are connected together by means of a pipe, in the middle of which a turbine has been placed. The first flask containing water at comfortable room temperature, is placed on a straw ring and the other flask is encased in a chamber of ice. When the vacuum pump is operated the water in the flask boils, and steam is generated. Here we have a steam engine, the heat of which would not be felt by the hands. Nevertheless, the steam generated drives the turbine at a speed of 5000 turns per minute. The difference of pressure between the two vessels in the experimental apparatus was less than three one-hundredths of an atmosphere.

It is clear that if we had some method of maintaining the condition described, that the turbine or other motor could be driven as long as our supply of water lasted. The water should be as warm as possible and in some way, the condenser, as we may term it, should be maintained at as low a temperature as possible. These conditions can be obtained from the tropical seas.

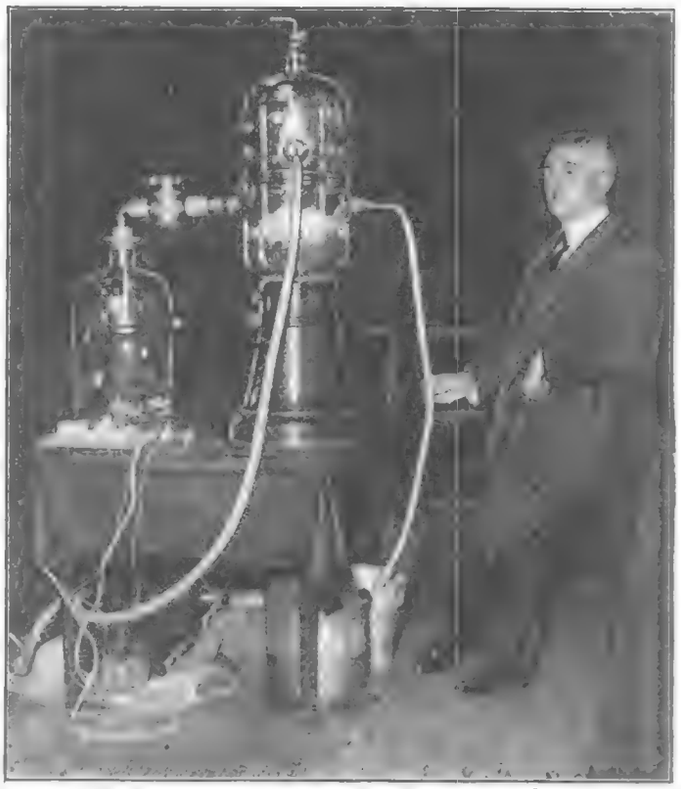
The tropical ocean has a surface temperature of from 26° to 30° Centigrade, practically 80° to 86° Fahrenheit while the water at a depth of 1000 meters (close to 600 fathoms) has a temperature in the neighborhood of 3° Centigrade (about 37° Fahrenheit). So here we have the conditions for practically applying the really astonishing experiment of Messrs. Claude and Boucherot. The water in the ocean can be obtained at the temperatures necessary to properly operate the turbine which in this particular case should be of immense proportions, but which could operate just as well as the experimental model. In the laboratory model, electrical current was produced from a generator driven by the turbine. This current was employed to light three lamps. Coincidentally, in the larger construction it would be possible to develop a tremendous amount of power limited only by the size of the available apparatus.

The inventors calculated that a definite amount of water vaporized under these conditions, developed energy equal to that which the same water would produce when falling from a height of 300 feet. It, therefore, follows that if we had pipes big enough we could obtain more power from the ocean for a given quantity of water than we could obtain with similarly sized pipes in Niagara Falls power plants. Thirteen hundred cubic yards of water vaporized by this system at a speed of 1 second for the entire vaporization would develop a power of 400,000 kilowatts of electrical energy.

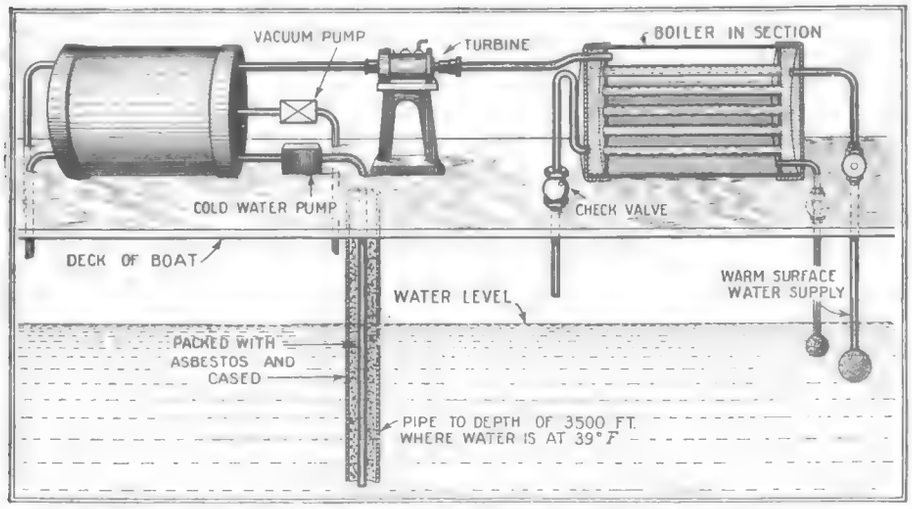
The diagram on this page shows the principle of this process as applied on the tropical ocean. A tubular boiler is heated by surface water which is kept flowing through the tubes. A feed-pump supplies the relatively small amount of water to be evaporated. The condenser is supplied with water pumped from a depth of 600 fathoms or thereabouts and this is used to keep the condenser cold. The pipe from the depths of the ocean must be thoroughly insulated so that the water reaches the surface at but a very few degrees above freezing temperature. A turbine is connected between the boiler and condenser and is driven by the generated steam.

Offhand it would seem that there is a good deal of power lost in the pumping operations but it will be observed that the net heights to which the water is raised, are quite insignificant and by placing the boiler and the condenser in the hold of the ship instead of on the deck, as we have shown them, the height would be zero and the pump would do nothing more than just circulate the water.

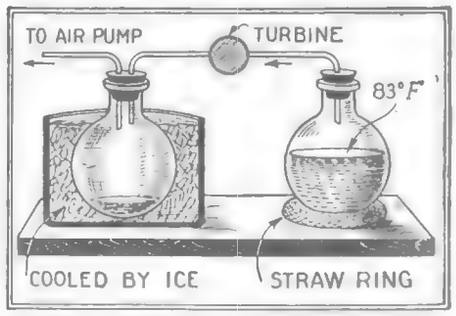
The efficiency of the apparatus would be very low, but where an entire ocean of water can be drawn upon, for the hot and cold water supply, efficiency plays a very minor part.



The above photograph shows Prof. Georges Claude who has developed a process for obtaining power from sea water. The apparatus in the picture is used for experimental demonstration of the principle of operation of this invention.



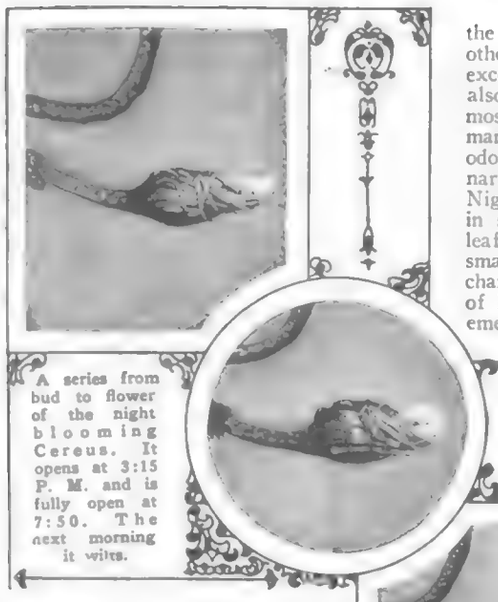
This diagram above illustrates the principle of operation of the method for utilizing differences of temperature of the ocean levels for producing steam and this steam in turn being the power which drives the steam turbines. With this method we can make cheap ice in the tropics.



Water at room temperatures was made to operate a small turbine as indicated in the diagram above.

Cultivating and Propagating the Cactus

By DR. ERNEST BADE



A series from bud to flower of the night blooming Cereus. It opens at 3:15 P. M. and is fully open at 7:50. The next morning it wilts.

WITH but few exceptions the cacti are natives of the tropical and subtropical regions of South and Latin America, where, in certain places, they have attained such prominence as to become the characteristic flora. These succulent stemmed growths, almost invariably provided with small and degenerated leaves, have accustomed themselves to a life in desert quarters and dry barren tracts. It is for this reason that the precious, life-giving fluid is stored either in certain cells, or within the entire tissue of their structure until such time as it is required by the assimilating organs and hand in hand with the accumulation of the water, transpiration is reduced to a minimum.

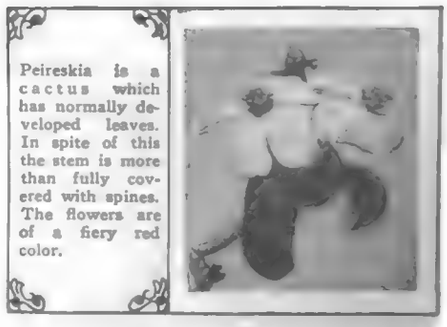
Within the trunks of the cacti is a profuse supply of mucus which tenaciously retains all water. It is this which makes it a possibility for the plant to shrink quite considerably only to resume its normal appearance after it has been well supplied with moisture.

Of all window-garden plants, none are so well adapted for indoor cultivation as this group of extremely interesting growths, for their demands upon the moisture content of the air lies far below the normal of most other plants. Then, too, their flowers are exceptionally showy not only in form, but also in size, and their colors vary within the most extended range of tints. Furthermore, many of them exhale a delicate and exquisite odor. With the exception of the extraordinarily beautiful flowers of the "Queen of the Night," there are few which can compare in size and individuality with the common leaf cactus, Phyllocactus. But even the smaller flowers have their own peculiar charm as, for instance, the violet-red flowers of Echinocereus from whose calix tube the emerald green pistil rises, providing a contrast of exceptional beauty.

It must be conceded that these charming floral offerings are very shortlived and that many cacti only flower at night. Even when not in flower, the cacti are always peculiar and interesting plant growths, their unique shape always interesting a lover of plants. Such peculiarities as the spines, sometimes wonderfully dainty, at others thick and massive, the arrangement of these spines upon the slight protuberances, their color, and the formation of the wool between them, tend to make for an individuality not found in any other family of plants.

On cultivating a cactus, the fact that the majority of species are leafless, must be taken into consideration. They cannot evaporate water as readily as other plants, since the surface for transpiration is much restricted, therefore, too much moisture should never be forced upon them. On the other hand, it is wrong to keep them too dry during their period of growth. They do not warn one by wilting or drooping when moisture is lacking. But then, too, they can easily be provided with too much water, especially if they have been placed in pots too large for their requirements. Since they have difficulty to thoroughly root in such containers, the soil becomes acid and root rot soon attacks them. Under such conditions it is advisable to transplant the cacti at once into smaller pots containing a fresh sandy soil.

In general the cactus is an unassuming plant which quickly responds to a little care and attention. A soft damp piece of cloth gently rubbed on the joints, frees them from the dust of the room. Occasionally some of them must be sprayed energetically, but then the water collecting in the joints and cavities found on such species as Mamillaria, Echinocactus, and Echinopsis, will usually evaporate quickly, otherwise it is to be removed with a sponge.

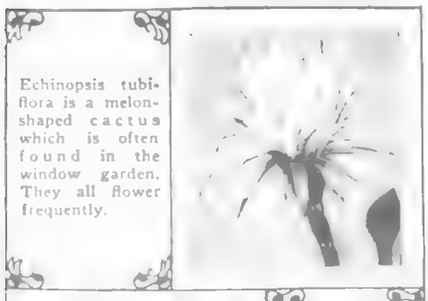


Peireskia is a cactus which has normally developed leaves. In spite of this the stem is more than fully covered with spines. The flowers are of a fiery red color.

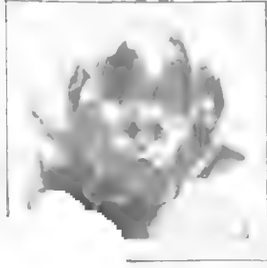
The wintering of the cactus should take place in some temperate or cool room and it is during this period that the light and air requirements are slightly reduced. During the months of March and April they are again placed in the light of the sun, and, when growth begins and new life pulsates through the plant, a larger quantity of moisture becomes a necessity. Then, too, a liquid fertilizer may be given; this not only stimulates the plant's growth, but also aids in the formation of buds and flowers.

As a general rule, the younger plants are always transplanted every second year in the month of May, the older forms remaining for three or four years before the pot must be changed. The containing vessel should rather be too small than too large so that roots may spread through the pot. The old, exhausted soil is shaken from the roots, and this is best accomplished by keeping the plant dry for about a week previous to its being taken out. The roots are not to be pruned. For soil take a clayey woodland type which is still further prepared by an admixture of sand, broken pot-sherds and fragments of lime, which make the whole extremely loose and facilitates the rapid drainage of the water. The pot also receives a foundation of pot-sherds. The plants are not to be set too deeply, the upper roots should just be covered

(*Continued on Page* 1154)

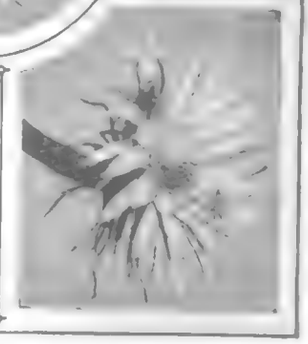


Echinopsis tubiflora is a melon-shaped cactus which is often found in the window garden. They all flower frequently.



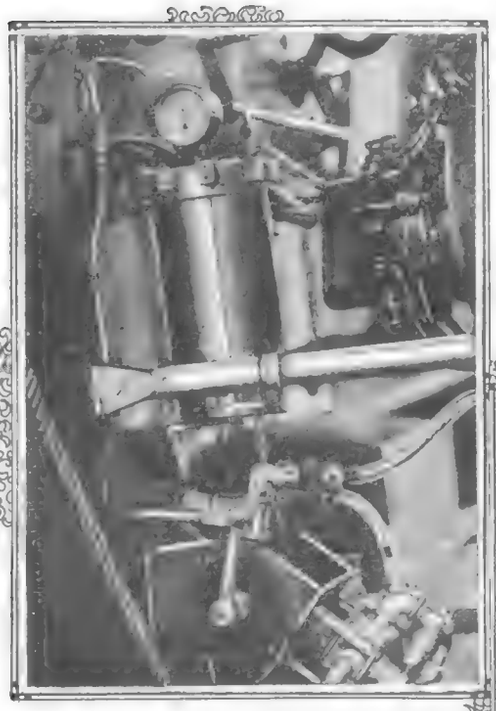
Opuntia tuna has a rich yellow flower. In fact all types of opuntias are characterized by this color.

When the flower is carefully watched one can see the motion of the sepals as they untwist themselves, unfolding the flower.



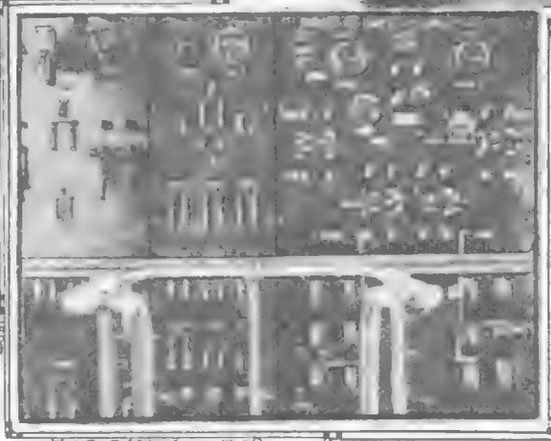
Science As Seen by the Camera

Some of the Month's New Developments in Various Fields of Research

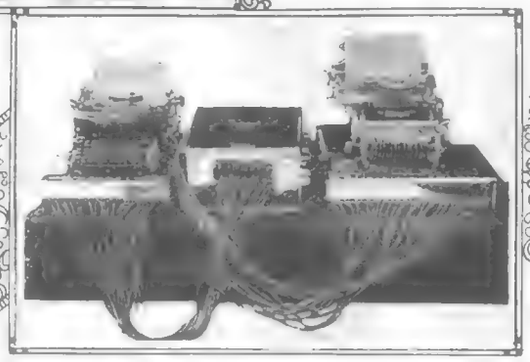


Every possible precaution for safety was observed in arranging for the Air Service Good Will Flight which started some time ago from Kelly Field, Texas. One of the most interesting devices used is the pressure fire extinguisher illustrated above. It is located under the cowling and occupies waste space. Each plane has a reservoir holding two quarts of extinguishing chemical, distributed to gas tanks by small pipes.

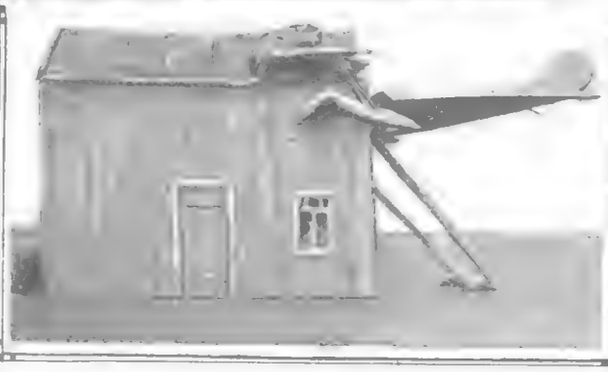
Electric tugboats were tried out for the first time in New York City recently. Here is one of the new New York Central electric tugs showing its paces against one of its steam-driven predecessors. The boat is controlled from the pilot house by the variable voltage system.



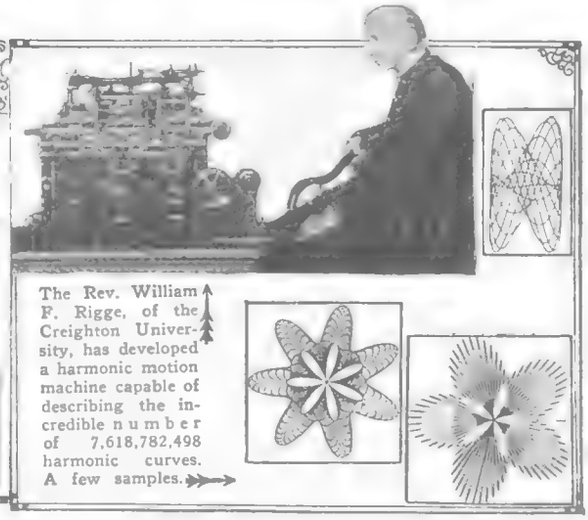
At the left is a photograph of the control board of one of the new electric tugboats. Current is generated aboard the craft, and the speed of the propeller-driving motors is controlled from the pilot house. The boat illustrated above is 108 ft. long and 26 ft. wide, and it is able to travel at a pace considerably above the average of tugboat speed. One of the most noticeable attributes of this boat is the fact that it is possible to keep it much cleaner than most boats are. It is smokeless.



A Berlin engineer, Alexander von Kryha, has developed a typewriter which automatically codes or decodes secret messages. This should be of great assistance in preventing the leakage of military and industrial information. The machines are operated by a series of relays and solenoids.



A thrill specialist, Finney Henderson, decided to crash his plane into a building from a height of one thousand feet just to prove that the stunt could be done. After the dust had settled, he emerged uninjured — but just look at the plane.

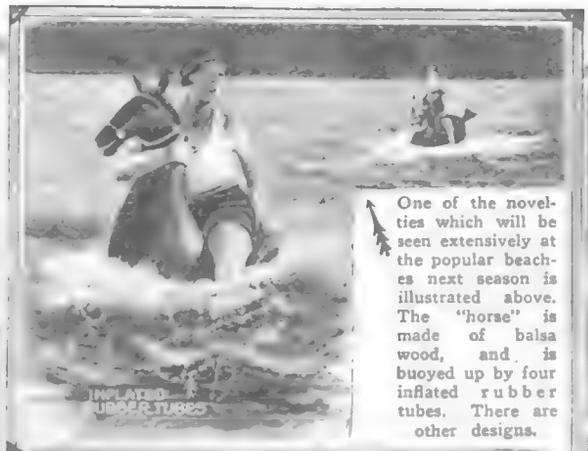


The Rev. William F. Rigge, of the Creighton University, has developed a harmonic motion machine capable of describing the incredible number of 7,618,782,498 harmonic curves. A few samples.

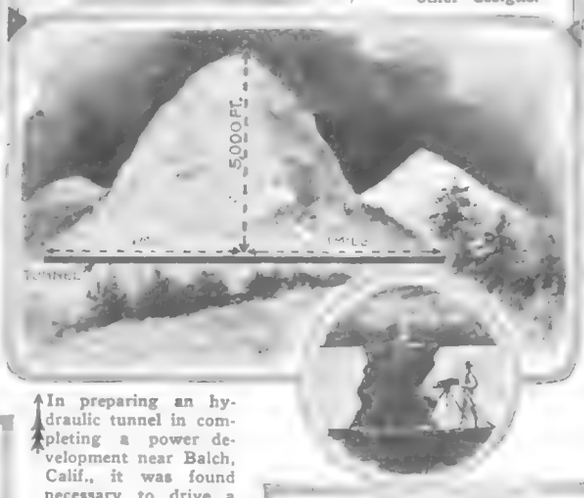
This Month's Scientific News Illustrated

By GEORGE WALL

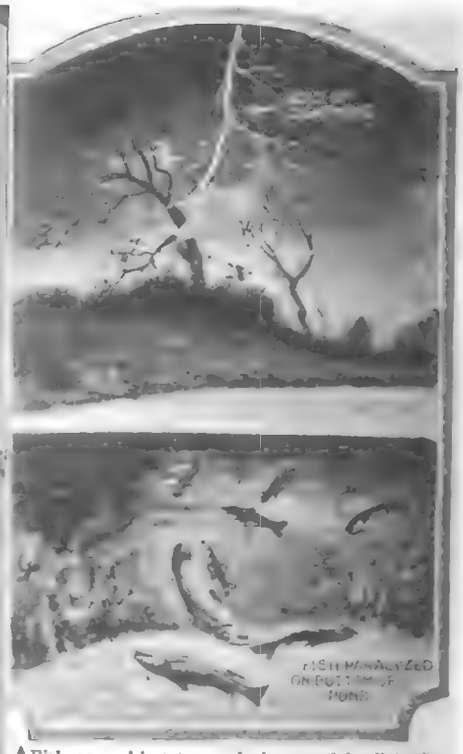
A news item from North Orange, Mass., tells us that a ladder is required to pick corn on the farm of W. E. Blackmer. Four of the stalks put on exhibition in a local hardware store were 14 feet high each and weighed a total of 28 pounds. This unusual magnitude was made possible by modern methods in fertilization and cultivation. Good climatic conditions are also conducive to extraordinary crops.



One of the novelties which will be seen extensively at the popular beaches next season is illustrated above. The "horse" is made of balsa wood, and is buoyed up by four inflated rubber tubes. There are other designs.



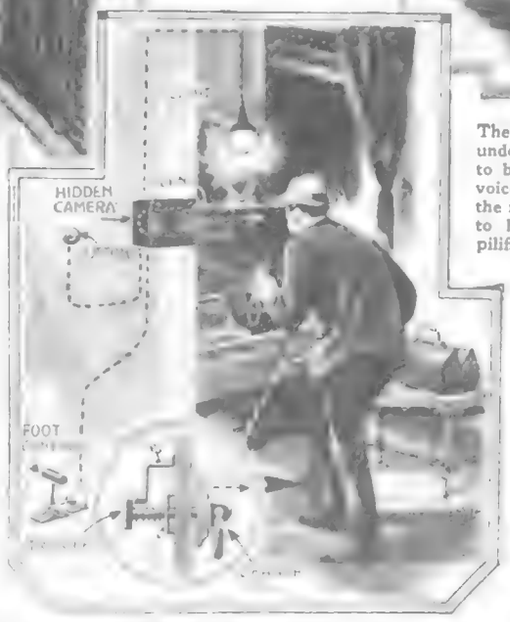
In preparing an hydraulic tunnel in completing a power development near Balch, Calif., it was found necessary to drive a 2-mile tunnel through the Sierra Nevada Mountains. The tunnel was drilled from both ends toward the center, and the work was so accurate that the walls and room of the tunnel showed no mark to indicate where the two had met.



Fish are subject to paralysis caused by lightning, the Bureau of Fisheries has found in a study conducted at its station at Craig Brook, Maine. After a bolt of lightning struck trees bordering a fish pond, several of the larger fish were found lying apparently lifeless on the bottom of the pool. They remained in this condition for several days.

The Cathedral of St. John the Divine, now under construction in New York City, is to be equipped with a complete system of voice amplifiers to enable the listeners in the most remote portions of the auditorium to hear the sermon perfectly. The ampilifier will be monitored by an expert operator.

The Southern Pacific Railroad, operating throughout the western portion of the United States, has inaugurated a new system of awakening passengers in sleeping cars by ringing chimes with an electric clock mechanism. The same system may be used for announcing meals.



The latest in thief-foiling devices is illustrated above. It is a camera invented by John E. Seehold of Indiana, that may be concealed in a house, or in a bank, to photograph criminals in the act at any time of the day or night. In the daytime, the camera may be worked by the pressure of one or more buttons; it continues to operate as a motion picture camera. At night, it operates automatically when intruders come in contact with triggers attached to door knobs, safe dials, etc.

Perfection of a new process for the treatment of bone injuries—a process that works anywhere from a week to several months more quickly than any other method—was announced by Dr. Frank H. Walks of Shreveport, La., at a recent session of the convention of the American College of Physical Therapy in Chicago. The new process consists of the application of high frequency electric currents from two opposite directions to the afflicted parts. These electrical discharges, meeting at the fracture, virtually weld the tissues together, according to Dr. Walk. It is more probable that the precise action involved is simply an acceleration through some electric stimulation of the re-formation of broken-down bone structure. It is also possible that some advantage is obtained through the natural effect on the surrounding tissues of the passage of the high frequency current.

A weight was attached to the string in the bottle. It swung and struck the sides of the bottle and in this manner answered questions.

Our Spiritualistic Investigations

NO. 9 OF A SERIES

By Dunninger.

FRAUDULENT mediums differ greatly in their methods. There are those known as trance mediums, who do not resort to any secretive paraphernalia. They simply go into an apparent trance, and with their eyes closed, seem to receive messages from the dead, which they call aloud, much to the bewilderment of their followers. Then there is the materializing "machine," which produces ghostly forms and visions, which they spiritually term, "ectoplasm." The fortune telling medium has also gathered armies of followers in the past several years, and uses spiritualism as a basis, or acting force, for clever misrepresentation. Recently, while in Cincinnati, I listened with great interest to a description of an entirely new kind of spirit mystic. This lady, known as Madam Bowerman, had become fairly prosperous, by demonstrating to numerous wealthy followers, that she possessed a gift of forcing her mind over matter. I found myself questioning many of those who had witnessed one or more of her séances, and learned that her offering was impressively unusual. Like many of her professional sisters, this wonder worker, was supposed to be difficult to see, and it was only those who came recommended, who were able to secure an audience with this gifted person. Through two gentlemen, who, by the way, are prominent business men in Cincinnati, a meeting with the wonder lady was finally arranged. Both of these gentlemen were originally non-believers, but, as they explained, they had been converted after several séances with this unusual person. I was asked to promise that I would in no way interfere with the lady's demonstration, nor was I to make my identity known, as these gentlemen, who so kindly arranged the meeting, were convinced of her genuineness. They were, therefore, not anxious to have the lady provoked through any series of questions, or tests, that they thought me likely to present. I agreed to their requests, and the appointment was made.

Busy as the medium was, an immediate sitting was quite out of the question, as I understood that no more than fifteen persons were allowed to be present at any one séance. The medium's popularity covered so wide an area, that I was obliged to wait for four or five days, before I would be permitted to be among the chosen few. Being of high intellectual order, and operating in a lavishly furnished apartment, the lady considered ten dollars a fair asking price for those desirous of a spiritual interview. Upon the eventful evening, my friends and I entered the mystic's parlor, and were greeted by an elderly lady of extremely fine type, who, with a broad smile, extended her hand to my friends, whom she called by name. They, of course, had been constant visitors, and were treated accordingly. They presented me, using a fictitious name, and the pleasing old lady, with a warm hand-shake, extended a most cordial greeting of welcome. I was impressed by the lady's fine personality, and was surprised when my friends quietly informed me that she was the medium.

I was introduced to many of the others present, all of whom seemed to know one another, and were evidently constant visitors to this house of mystery. As we reached her abode rather early, we were obliged to wait a half hour or so, until all the expected guests had arrived. A tall grandfather's clock, in mellow tones, struck ten. Automatically, the guests who had

(*Continued on page* 1152)

$21,000.00 for Spirits

Dunninger, who writes exclusively for SCIENCE AND INVENTION Magazine and who is the Chairman of our PSYCHICAL INVESTIGATION Committee will personally pay $10,000.00 to any medium or spiritualist who can present any psychical manifestation in so-called spiritualism, that he will not explain or that he cannot reproduce by natural means.

More than two years ago SCIENCE AND INVENTION Magazine offered a prize of $11,000.00 to anyone who could demonstrate his or her ability to communicate with the spirits or to give some definite form of a psychical demonstration which in itself was not trickery.

The result has been that mediums and spiritual organizations have been afraid to place proofs before us. Those weak attempts which have been made to demonstrate psychical phenomena were almost instantly proven fraudulent, and no medium has dared to contradict our findings.

In view of these facts, should we not consider all mediums fraudulent?

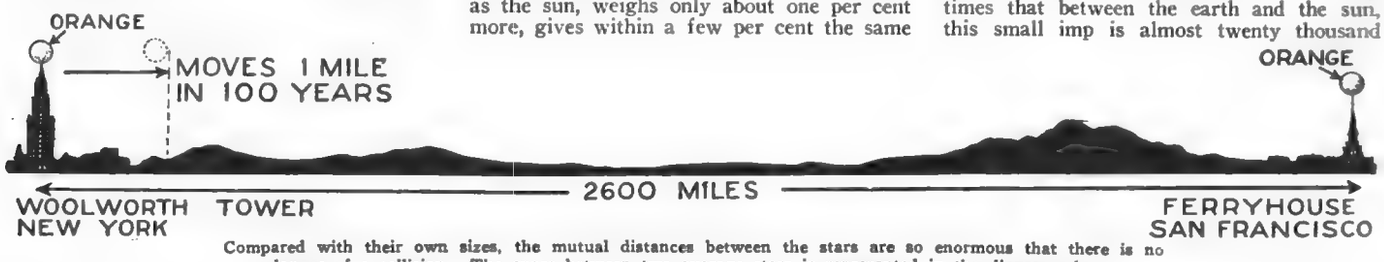
To the $10,000.00 which has been offered by Joseph F. Rinn through this publication for Spiritual proofs and the $1,000.00 in addition offered by SCIENCE AND INVENTION Magazine we now add Dunninger's $10,000.00.

So now we have a total of $21,000.00 offered for proofs of Psychical Manifestations. Spiritualists—get busy.

The Sun and Its Neighbors

By W. J. LUYTEN,
OF THE HARVARD COLLEGE OBSERVATORY

IF you have ever looked up to the sky on a dark night, free from moonlight, and have seen the thousands of twinkling stars, and if, furthermore, you have heard astronomers tell you that with their telescopes they can see, not thousands, but millions of stars, you have perhaps wondered how there can be room for all of them. Why don't they run into one another? Do the stars obey the traffic rules of the universe? These and other questions have now been answered and we know exactly what the habits are of our neighbors in space, in fact, we have grown to be quite friendly with each other. But before we actually go to pay a call on them let us examine our means of locomotion and make sure that we sha'nt run out of gas on the road.

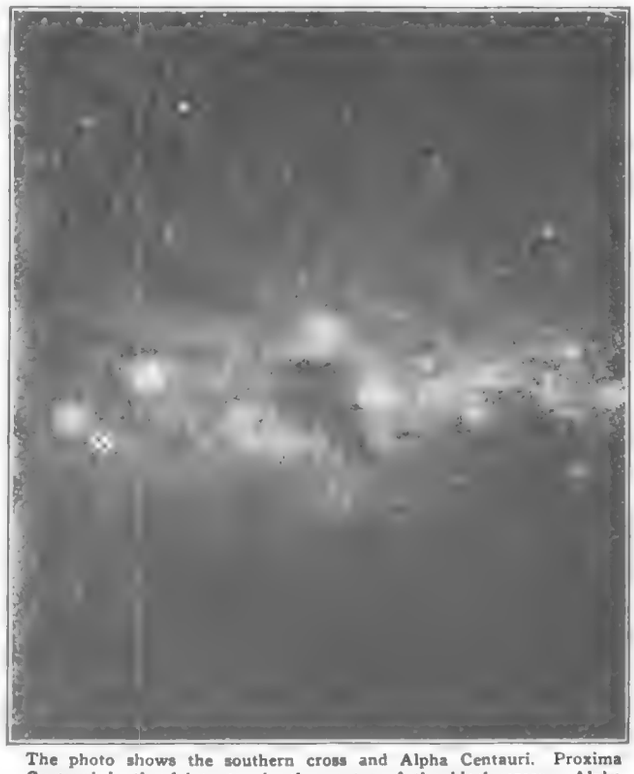


Compared with their own sizes, the mutual distances between the stars are so enormous that there is no danger of a collision. The space between two average stars is represented in the diagram above.

THE present article is the first of a series which are to appear and come from the pen of Prof. W. J. Luyten of Harvard College Observatory. Many of our readers no doubt have read some of the many popularly written articles on our celestial neighbors in space, prepared by Prof. Luyten, and which have appeared in the daily press. We think the author has a way of presenting this subject which will appeal to all of our readers, both young and old. We shall be pleased to have your comments.

THE CELESTIAL YARD-STICK

Here on earth we measure in inches, feet, and miles, but the moment we leave the earth behind us, a mile is of no use to us; it is so small that we must look for something else. Even our own satellite, the moon, our very next door neighbor, is 240,000 miles away; the sun is even 92,000,000 miles distant. And when it comes to the stars, we need a whole line to write down their distances: 25 trillion for the very nearest, 25,000,000,000,000! Obviously we had to do something about it, and naturally we have made use of the speed of light. Light, going 186,000 miles a second, is about the only thing fast enough for us. In an hour it travels more than half a billion miles, in one year more than five trillion. Even so it takes light more than 4 years to reach the nearest of all stars, Alpha Centauri, ten years to bridge the gap between us and Sirius, the Dog-Star, so that really Sirius is only telling us what happened there in the fall of 1916. Pollux, the brighter and nearer one of the Twins, is still farther away; we are only just receiving the messages it sent in 1893. Castor, its twin brother in the sky, is much more remote, it is *twenty years behind* Pollux. The Pole star we see still in the beginning of the eighteenth century, and the Belt of Orion is still struggling in the Dark Ages. Let us not go back too far into history, however, even the stars might resent our inquiring into their past; let us rather make the acquaintance of Alpha Centauri. This is the third brightest star in the sky, a faithful follower of the (Southern) Cross, but unfortunately invisible from New York City. Only Florida and Texas have the privilege of seeing it. Looking at it now, we see it just as it has begun the year 1922, and we see that it is composed of two stars, suns we may call them, which revolve around each other in eighty years. The brighter and bigger one of the two is a twin brother of the sun in almost every respect. If we were able to put them side by side we should find that this star is of the same size as the sun, weighs only about one per cent more, gives within a few per cent the same amount of light, has the same temperature and is composed of the same chemical elements. The other, fainter component of the double star Alpha Centauri, is like a step-brother: it has received a little bit less of everything from Mother Nature. Very recent observations have shown us that there is yet a third star belonging to the system of Alpha Centauri. This third partner of the firm is very small, and insignificant; it gives less than 1/10,000 of the light of the other two. But whereas the average distance between the two brighter ones is twenty times that between the earth and the sun, this small imp is almost twenty thousand times as far away from the two brighter stars. It is also a little closer to us: Alpha is 4½ light years away, the little star only 4 years 3 months. It is "three months closer to us." Yet in spite of all this, the iron hand of the law of gravitation makes it unmistakably a companion to Alpha, and together they travel through space. It looks as if Proxima, for this is the name of the faint little red star, was just put there to serve as the tail-light of the celestial omnibus, of which the two bright yellow stars form the headlights. The faint star also carries the number plate of the system; on the books of the Celestial Police Department it is registered as C.P.D. -60 -5483.



The photo shows the southern cross and Alpha Centauri. Proxima Centauri is the faint star in the center of the black cross. Alpha Centauri, our nearest star, is the bright star to the left of the cross.

HOW STARS MOVE

And so we come to another point of interest about the stars. They move. Although Alpha Centauri is one of the "fixed stars," it moves, as all the others do. The spectroscope has shown us that it is approaching us with a speed of 14 miles a second. Fifty thousand miles per hour. Almost half a billion miles per year. But, since the distance from us is 25 trillion miles, it has a long way to go. And even then it would never hit us, for it also moves sideways. Alpha Centauri is changing its position in the sky; it is running northwestward toward the top of the Southern Cross. If you want to know how much it moves in a year, imagine that some one night you put a dime on the sidewalk on lower Broadway, with a small firefly in the middle. Then climb on top of the Woolworth Building and (taken for granted the dime is still there) see if you can find the firefly. If you can see it, and if the fly crawls to the edge of the dime in one year, you have seen something that moves relatively as fast as Alpha Centauri does. You may not think much of it, but we do. Our best telescopes would show us the motion of that firefly in ten days, and we call this motion very large. At any rate, at the distance of Alpha Centauri this corresponds to 13 miles a second.

If we combine this motion with the approach at the rate of 14 miles per second, we can lay out the complete course along which Alpha Centauri is navigating through space. And we calculate that in about 25,000 years it will be as close to us as three light-years, its minimum distance. It will then be much farther north, in the constellation Hydra, and well visible from New York

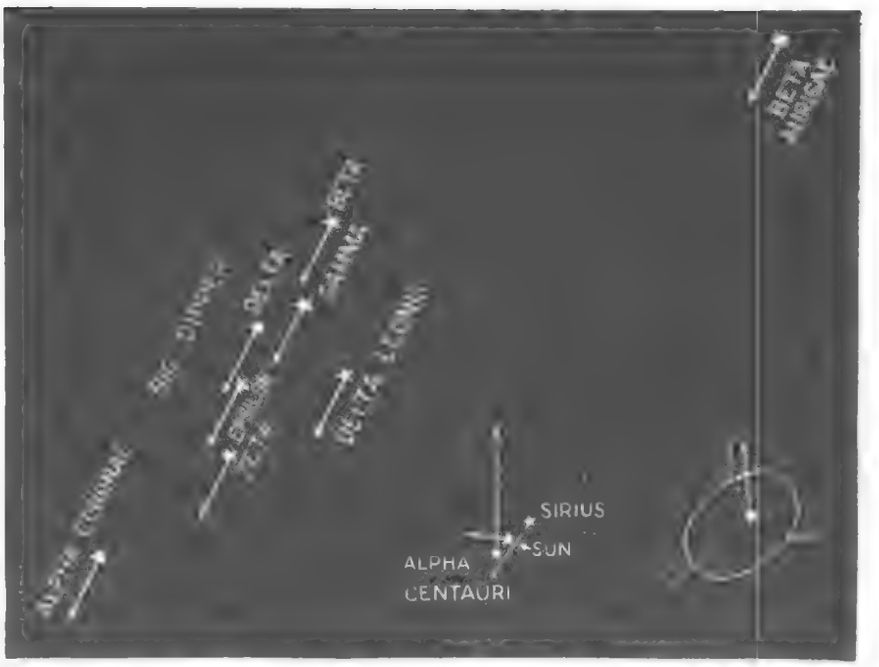
City. In the meantime it will give us some magnificent spectacles in the southern sky. Around A. D. 6000 Alpha and Beta Centauri, two of the very brightest stars in the sky, will be about fifteen times as close as are now the "pointers" of the Big Dipper. Around the year 14,000 Alpha will shine north of the Cross and form an extension of it. As little as one thousand years back, *i. e.*, long after the Arabs began naming the constellations, Alpha Centauri was in a position in the sky which we now consider to belong to the constellation Circinus. Well, one may ask: What is in a name? when even star names are no longer permanent, but prove changeable by *Time*.

MEET SIRIUS, THE BRILLIANT DOG STAR

Another neighbor whose acquaintance it is well worth making is Sirius, the Dog Star, most brilliant of all stars and the gem of our winter skies. It is a good deal larger than the sun and between two and three times as heavy. It gives in reality twenty-five times as much light as the sun, but because it is ten lightyears away from us, it *appears* to us ten billion times fainter than the sun. Like Alpha Centauri, it has a little companion trailing along behind it. The history of its discovery is one more incident of the marvelous precision of astronomical measurement. It had long been known that Sirius was moving in the sky, and that it had a large motion. Using again our observer standing on top of the Woolworth tower and looking down on Broadway, we should say that Sirius moves the thickness of a half dollar piece in one year! In addition to this, it was soon found that Sirius did not move regularly in a straight line, but advanced more in some years than in others and swayed to and fro.

Astronomers did not like it: no decent star is allowed to behave that way. So they started figuring, and soon found that there must be another star going around Sirius, which made the bright star deviate from its path. They knew this for certain and even predicted the place of that little star—it was discovered before it had been seen. When later on they looked for it in Cambridge with a telescope which had just been finished, they saw it, too.

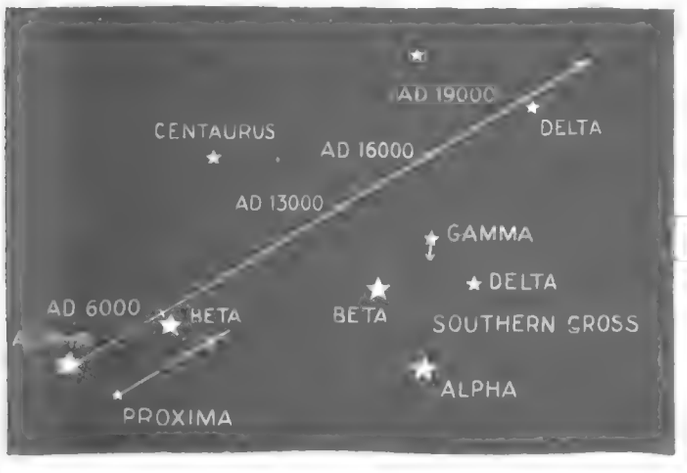
This little star is the pride of present day astronomy, one of the most cherished and most miraculous objects in creation. Listen only to this: Astronomers soon found out that it went round the big star in fifty years, and from that they calculated that it weighed about as much as the sun. They measured its brilliance, and since we know the distance, we also know its total light, its candle-power, which is 400 times smaller than that of the sun. The third quantity they measured is the temperature that gives us the brightness per square inch, and since we know the candle-power, we can calculate how large the surface and therefore what the size of the star is. And thus we came to the remarkable conclusion that this companion to Sirius is but little larger than our earth, but weighs as much as the sun. One cubic inch of this star must weigh more than a ton on the average. The substance this star is made of is 2,000 times as heavy as gold. And yet the outside layer of the star contains principally Hydrogen, the lightest of all gases.



How some of the stars are moving in space. The little group on the right gives an idea of the real position of the Big Dipper family pancake, with the sun and its motion relative to the pancake.

It all comes down to the old, old theory that matter is really full of holes, so full that if we could take these holes away, we could compress matter to ten or a hundred thousand times the density of gold. And, curiously enough, the only way we can attain this is at very high temperatures, several million degrees centigrade. The only place where we find such temperatures is in the interior of a star. And so here we are: On the outside this star is several thousand times rarer than the air we breathe, and several thousand times as heavy as gold in the inside.

Unlike the sun, with its planets, or the triple system of Alpha Centauri, Sirius and its companion do not form a solitary system in Space, but are members of a very large family—the group of the Big-Dipper stars or the Ursa Major Cluster, as astronomers call it. The main body of the cluster is formed by the five central stars of the Dipper, and we know that a great many stars all over the sky belong to the same group—distant cousins, we may perhaps call them. The tracing of pedigree in the Universe is very difficult because it has to be so exact, in fact, the criterium to which the members of this cluster must conform is that they must all have precisely the same speed and the same direction of motion. Doubtless they are of common ancestry, but when and where they originated we do not know. Like the cells in animal and vegetable life, they can enlarge their family by dividing themselves in two, but alliances with chance acquaintances are strictly forbidden in the ethical code of the universe. In their journey through space, driven by the same hidden force, onward to the same, unknown destiny, they must travel alone, rely only upon themselves. If we should make a small model of this group we should find that the stars in it form a pancake-like figure and the only reason that we see them all over the sky is that the sun just now happens to be inside the pancake, athough not made of the same dough. An official from the Celestial Ticket Offices (consolidated) has informed us that this Ursa Major cluster has bought tickets on the express going in the direction of the constellation Aquila, whereas our sun has reserved a drawing room for all the planets on the Herculean Limited, a fairly slow train going in the direction of the constellation Hercules, with a speed of no more than 12 miles a second. Consequently we are gradually leaving the pancake-family behind us; in 50,000 years we shall be able to see the whole pancake at once, but it will take several millions of years before the pancake has shrunk to the size of the full moon.



The changing sky—How Alpha Centauri will behave during the next 200 centuries.

STARS OBEY TRAFFIC LAWS

Of course, the Sun, Alpha Centauri, and Sirius aren't the only stars moving in the universe. All the "fixed stars" are moving, some slow, some fast, but none of them stay put. At first sight this chaos of millions of stars moving with different speeds in different directions is bewildering; a little study soon shows that the Universe has its traffic laws, not man-made laws, but laws of Nature from which there is no escape. To begin with there is the speed limit. There is only one, but this one is really universal: No star shall surpass the speed of light. This is more than just a law, it is the constitution of the Cosmos, and no amendments are allowed! Next—the tendency of all stars to move parallel to the Milky Way, or even more specialized to follow one particular boulevard along the Milky Way. There are far more stars moving along this highway of space, than there are stars moving across it, and it seems almost as if the Cosmic Traffic Department had instituted a "boulevard stop" for all stars crossing this "Great White Way"; all stars must slow down before they cross. This is probably done to give more freedom to the speeders along the boulevard, for we know a great many stars

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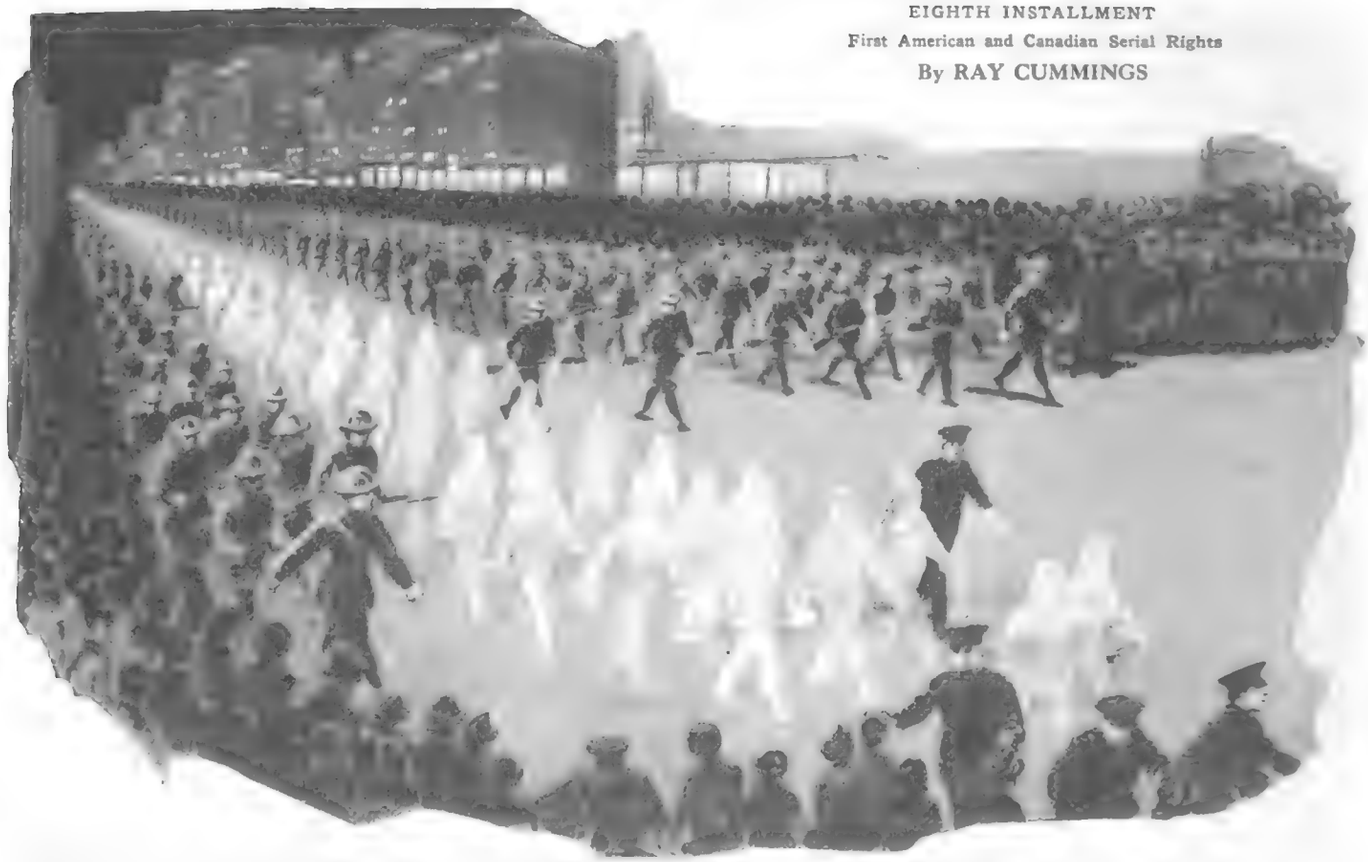
Into the Fourth Dimension

EIGHTH INSTALLMENT

First American and Canadian Serial Rights

By RAY CUMMINGS



"Our advance was followed up above. From every window people were peering fearsomely down at us. The cross streets were jammed. But ahead of us, policemen were clearing them. And down empty Broadway, and down each of the avenues, troops of the State Militia were marching."

CHAPTER XV

THE MARCH OF THE GHOSTS

I REMAINED a captive of Brutar; and at length the time came when he was ready to start his conquest of Earth. His army, his followers, quietly had departed from the encampment, and were waiting for him in the Borderland. He stood before me—we two the last living minds remaining in his self-created realm. Around me I could see it even then beginning to rot and crumble.

He said, "The blood of the lolos is ready for us, Rob. But before we start I will warn you—if once more you try to escape you will be killed." I could not doubt but that he spoke his true intent.

He brought then a bowl, or brazier, in which like food the dried burning blood of the lolos was glowing. It was a dull red in the gloom, with tiny green tongues licking upward from it. I could not see the smoke. But I could sense it—smell it. We reclined by the brazier. The fumes brought a reeling of my senses. Unpleasant, frightening. . . . Then pleasant indeed. A drowsy drifting into rosy vacancy. I had intended not to yield myself wholly, but my will weakened . . . I told myself that Brutar would guide me. . . .

Out of the darkness at last with returning consciousness I found a gentle net of Brutar's thoughts cradling me. And himself regarding me impatiently.

"Come, Rob. We are here. Stay close by me—and if you help me as I wish, reward shall be yours."

There was a tenseness to his voice. I gazed around. We were in the Borderland—that same dark void with its rolling slopes. Near at hand I saw some two hundred of Brutar's workers—his fighters—drawn up in orderly array. Shadows like myself. And behind them a rabble of Egos in the fashion of men, women and children. His followers, waiting to enter the Earth-realm when the fighters had conquered it.

I saw, too, hovering near Brutar and me, a dozen shapes of men—the leaders of Brutar's army awaiting his instructions.

When I was more fully alert Brutar drew me aside. He spoke with a new force and succinctness. Because now the time for action had come and I think also that as we neared our Earth-state, there was a tendency

Synopsis

Robert Manse, a correspondent in the New York Office of a Latin-American export house, in company with Wilton Grant and his sister Beatrice, saw the first of the ghosts in February, 1946, a few miles from Rutland, Vermont. These ghosts were semi-transparent, glowing figures much resembling human beings. Attempts to destroy them with bullets or clubs had no effect on the shadows.

Some time later, Will calls Rob on the telephone, saying that his sister Bee is quite ill and asking Rob to pay them a visit. During the visit Will mentions that the ghosts have already arrived in the Borderland between their world and ours, and that they are on the point of coming into our world. Will himself has discovered a means of entering into this borderland and declares that even though he is being watched by [illegible] ghosts he will make an attempt to [illegible] realm and turn the spirit-like [illegible] into their former paths. While [illegible] journey, Rob is to stay [illegible] Beatrice.

The preparations for the experiment are made, and Will clasps upon his arm a connection to the vibration-transformer which, by altering the vibrations of his body, is to transform it from normal substance to the wraith-like material of the other world. They see a ghostly form watching them as Will's body becomes transparent. Finally the apparatus is disconnected and they wait for his return. Five hours later, Will returns saying that they must go back with him to save the world from an invasion of the ghostly hordes.

Robert and Beatrice, though face-to-face with the unknown, succeed in suppressing their fear, and agree to accompany Will across the border. The three adventurers don their metallic garments, attach the batteries, and swallow the pill compound which is to transform [illegible] In a few minutes they find themselves transposed into the Borderland.

They meet Ahla who takes them to the big city. The triplet is told that Brutar is inducing his followers to enter our world. A battle of thoughts takes place among the ghosts. Brutar captures Rob and Bee with thought waves, and tells them that he can use them for his conquest of the earth. Will and Ahla go to the rescue.

Brutar brings a young man, Eo, on the scene and they both listen to descriptions concerning earthly life. Brutar shows how material things are made from thought waves. He also shows Rob and Bee the lolos plant which has a conscious mind. The blood from this plant enables the ghosts to enter our realm. During the demonstration Bee and Eo escape.

Eo is stricken by Brutar by an evil power of mind and becomes insane, passes to the realm of death and leaves a ghostly body behind. This dissolves like a fog. Thone describes to Bee and Will how thoughts create new life. He also states that his own men are preparing to attack Brutar if they can locate him. Suddenly Ahla exclaims she knows of Brutar's encampment. On reaching the place, they find everything dissolving. Brutar, taking Rob with him, starts his invasion of the earth.

Now continue with the story.

toward restoration of all Earthly qualities.

"Rob," he said, "I'll tell you now my plan. Your greatest city is near at hand—somewhere near here."

"New York," I said.

"Yes. I plan to attack it—demolish it. It's a very small portion of your Earth, of course, but with that evidence of my power I think your Earth-leaders will cease to fight me—will admit my supremacy. If not—well then I shall demolish each of your great cities in turn——"

He told me then that these two hundred men, with his dozen sub-leaders, were all the fighting force he at first proposed to use. We were about to attack New York City. His people would wait, here in the Borderland, for our success; then would enter the Earth-state to take possession of it.

"You can help me, Rob, because you know your city better than I do. Look around us now—tell me exactly, where are we?"

I saw then the shadows of ghostly houses. My own world! Grey, spectral houses . . . streets . . . a church . . . trees lining a street of residences in a small quiet town. It lay in a plane tilted at a slight angle, and perhaps thirty feet above us. I looked up to the street overhead. Quiet? It was thronged with people — ghostly shapes crowded up there staring down at us. It seemed to be night up there; I could see the street lights; spots of light in the houses, and the headlights of scurrying automobiles.

The town was in a turmoil. I knew that its people saw us down here as a myriad half-materialized ghosts. They were crowding to watch us. They realized that now at last the ghosts had come in a horde! Perhaps to attack. I saw policemen on the streets; and presently a company of soldiers came along. Spurts of flame showed as evidently they fired tentatively toward the ground. But there was no sound.

Brutar chuckled. "Well, they're really frightened now! And they have cause to be. Where are we, Rob?"

It semed possibly a suburb of New York City. I did not recognize it at once. Then off to one side I saw a shadowy river, with ghostly cliffs on its further bank. The Hudson!

"I don't know where we are," I said carefully. "Where do you want to go first, Brutar?"

"To New York City—down there where there is river all around, and a great pile of buildings."

Lower New York. But I would not lead him. I protested ignorance.

A shape approached us, a man. He gestured. "I know it is that way, Brutar."

We started. The two hundred fighters in a triple file came after us. Brutar had ordered the mob of men and women to wait where they were. We advanced slowly, and I saw with sinking heart that we were going southward. Upper New York City soon lay close ahead.

It was a strange, soundless march. The slopes of the Borderland carried us sometimes above, and sometimes below the ground of Earth. But generally we were below it. Up there over our heads the shadowy landscape was silently slipping backward. It was all too familiar now. We were under upper Broadway. Huge apartment houses loomed high up there, with the Hudson almost at our level to the right.

Our advance was followed up above. From every window people were peering fearsomely down at us. The cross streets were jammed. But ahead of us policemen were clearing them. And down empty Broadway, and down each of the North and South Avenues troops of the State Militia were marching, keeping as nearly as possible directly over us.

"Brutar," I said, "you cannot fight this world. Look at them there. They're ready—waiting."

Machine guns were posted at most of the street corners now; and as we passed beneath them they were moved swiftly forward to other streets ahead of us. The boat traffic of the river was being cleared. Police boats, armed and ready, were paralleling our march. A war-vessel lay anchored ahead, off Grant's Tomb. Its funnels were smoking, and as we neared it, very slowly it steamed along with us.

And over in Jersey and on Long Island I had no doubt they were ready with watching troops and every precaution. Let one of us who now were mere ghosts dare to materialize further, and at once we would be killed. What could Brutar do?

He laughed at my thoughts. "You shall see, Rob, when we get among the great houses and I lay my weapons."

I could not fathom what he meant, but the sure confidence of his tone had an ominous ring to it. Weapons? I saw none. We were empty-handed, Brutar and I. And the twelve sub-leaders were empty-handed as well. But of Brutar's attacking force marching behind us, I had noticed that each man was carrying a single article. I could not call them weapons; I did not know what they were. They seemed more like grey, ghostly bricks, each man carrying one.

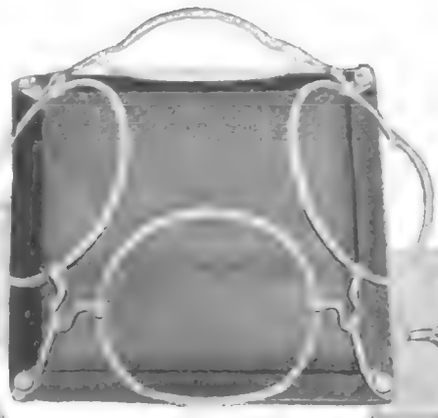
What were they? I could no more than guess. Some material, doubtless of Brutar's creation, brought into this Borderland state. Would these ghosts, each with a simple brick like these—would they dare to materialize—dare to enter our Earth-state upon an equality of being with the armed, massed troops awaiting them? It seemed incredible. Two hundred ghosts marching in spectral array beneath the city, with soldiers above;

"A breathless instant. Slowly at first, like a felled forest giant, the great Woolworth Building was coming down. Slowly, then with a rush, it fell to the south—fell in great shattering segments. Crashed with a soundless crash upon the several blocks of nearby buildings. Crashed and tore with the thousands of tons of its weight, smothering everything beneath its crashing masonry and steel."

FIRST AWARDS IN $3,000.00

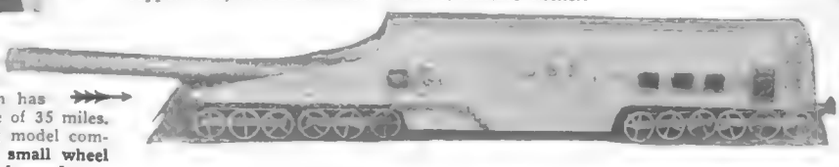
At the left Miss Rose Bloomberg is shown demonstrating the wirekraft toaster. The toaster will hold four pieces of bread at one time.

Wirekrafters send in your models now and win one of the monthly awards offered by SCIENCE AND INVENTION Magazine. Three thousand dollars in prizes are to be awarded during the fiscal year. The first prize is for utility only. The second and succeeding are awarded for either utility or artistic, decorative or constructive effect.



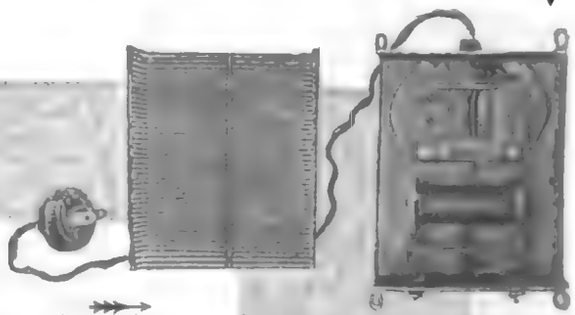
First Prize—$100.00, awarded to the constructor of the gas toaster illustrated above. The model arrived untagged and consequently no name can be given. The toaster is a utilitarian object and therefor is of the type suited to the first prize award.

Fifth Prize—$15.00 was awarded to Mr. J. Hess for his model of the baby carriage shown here. The carriage is entirely constructed of wire. The body is cleverly made from enameled copper wire, which has been woven to imitate wicker.

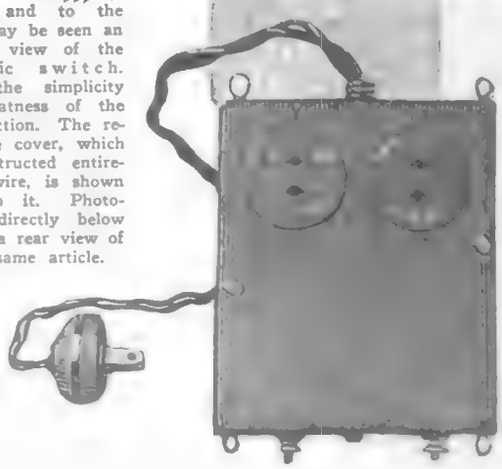


Fourth Prize—$20.00 was awarded to Mr. H. Vogt of Marshall, Michigan. It is an exact replica of the gun used by the United States Navy. This gun has a calibre of fourteen inches and a range of 35 miles. The reproduction in wire is a working model complete in every detail. **By turning the small wheel at the side, the elevation may be changed.**

Sixth Prize—$10.00 awarded to Mr. J. Williams of Chicago, Illinois, for the switch or cut-out shown.



Above and to the right may be seen an interior view of the automatic switch. Note the simplicity and neatness of the construction. The removable cover, which is constructed entirely of wire, is shown next to it. Photograph directly below this is a rear view of the same article.



Eighth Prize—$5.00 awarded to Mr. H. R. White for his model of an automatic music leaf turner. Letter A in the photograph shows the catch holding the leaf in position. B shows the handle which releases the catch A. C shows the piece of rubber used as a spring. When handle B is pushed to the right the sheet of music is automatically turned. The rack will conveniently hold an ordinary sized sheet or book. The page to be turned is held in place by two clips, one at the bottom and one at the top. The model is painted white and presents a very neat appearance.

The automatic switch in the above photograph is constructed entirely out of wire. The builder even went so far as to make the nuts from pieces of bus bar. When the radio set is turned on, the B eliminator is connected to it, and the A battery trickle charger is automatically turned off. When the A battery is turned off, the trickle charger is then automatically turned on and the B eliminator turned off. The model was carefully soldered and presents a sturdy and neat appearance and will prove to be a most valuable adjunct to any radio set.

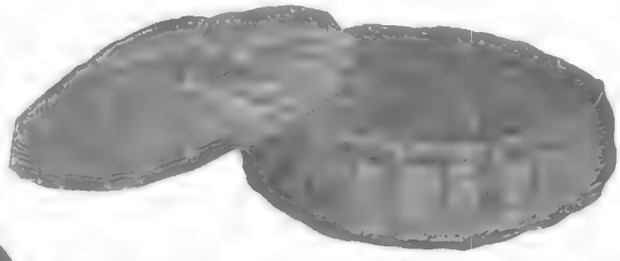
WIREKRAFT CONTEST

Ninth prize—$3.50, awarded to Mr. R. Henry of Fox Lake, Wisconsin, for his wire model of the bird lamp shown in the above photograph. The lamp is shown casting its glow upon the book being read by Miss Cleo Frager. The frame of the lamp is of wire.

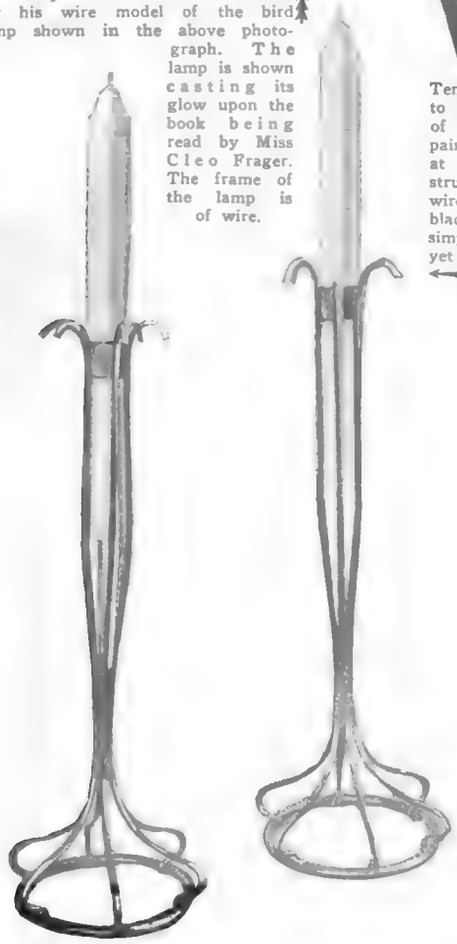
Tenth prize—$2.00, awarded to Mr. C. W. Vandeusen of Auburn, Ind., for the pair of candlesticks shown at the left. These are constructed from heavy iron wire which has been painted black. The holders are simple in construction and yet will grace any home.

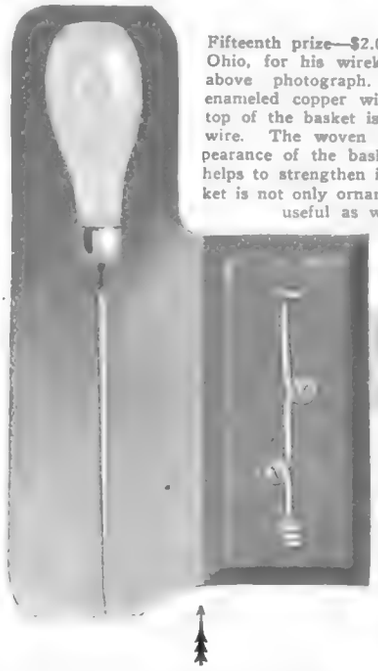
Second prize—$50.00, awarded to Mr. W. F. Saunders of St. Louis, Mo., for his wirekraft necklace worn by Miss Lucy de Corredor, shown in the photograph below.

To the left we have a close-up view of the fine necklace. The necklace is correct in every detail and is of exceptional construction. The small links are carefully fashioned from fine silver wire. The novel mounting of the three stones in the pendant should be noted. Around each stone is a border of fine wire which adds to the decorative effect and also helps to keep the stone in place. Surrounding the largest of the three stones is a fancy net work or border of wire. The necklace has evidently been constructed with patience and care.

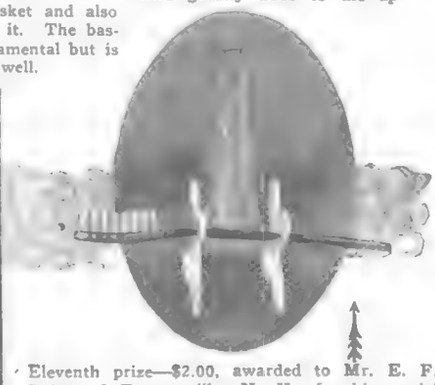


Fifteenth prize—$2.00 awarded to Mr. Pearl Loomis, Gloucester, Ohio, for his wirekraft model of a work basket shown in the above photograph. The basket is constructed entirely of enameled copper wire which has been artistically woven. The top of the basket is decorated with rings and tassels made from wire. The woven effect of the wire greatly adds to the appearance of the basket and also helps to strengthen it. The basket is not only ornamental but is useful as well.





Sixteenth prize—$2.00, awarded to Mr. R. J. Williams, Chicago, Ill., for the ice pick and holder shown above and a little to the right. The model is constructed from heavy nickelplated wire and is mounted on a hard wood base which serves to attach the holder to the wall or ice box. The model is simple in construction yet its usefullness is obvious. The point of the pick fits snugly into a coil of wire at the bottom of the holder. The top is also held in place by means of a ring of wire.

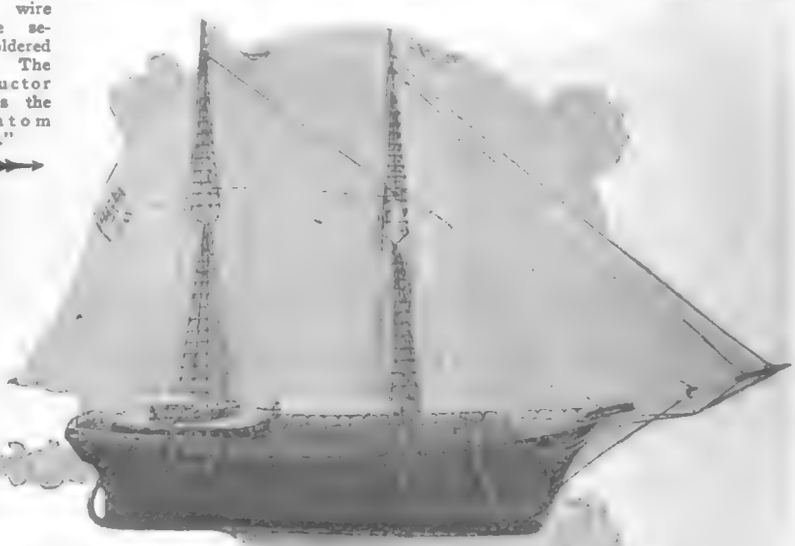


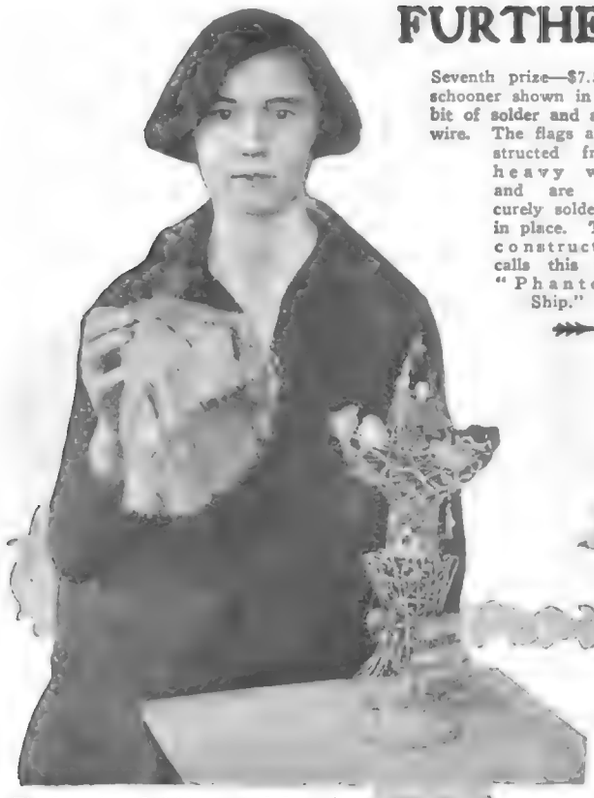
Eleventh prize—$2.00, awarded to Mr. E. F. Baker of Tannersville, N. Y., for his model of a tooth-paste and tooth-brush holder. The model is constructed of heavy wire, one end of the tube is inserted between the cross bars of the holder. Any pair of the four legs of the end pieces may act as the base of the holder. The loops in the end pieces may be used to hold a tooth brush if the holder is used for tooth paste or a safety razor and a shaving brush may be inserted if the holder is used for shaving cream. The users of the holder are enabled to use the full content of the tube.

Rules for Wirekraft Contest will be found on page 1164

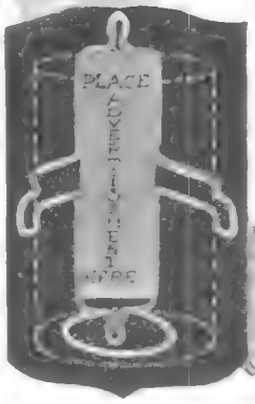
FURTHER WIREKRAFT AWARDS

Seventh prize—$7.50, awarded to Mr. C. W. Vandusen, Auburn, Ind., for his model of the wirekraft schooner shown in the photograph below. The vessel, a fore and after, is constructed entirely of wire, a bit of solder and a little paint. The body of the ship and the sails are constructed from ordinary screen wire. The flags and pulleys are also made entirely of wire. The masts and ladders are ingenously constructed from heavy wire and are securely soldered in place. The constructor calls this the "Phantom Ship."

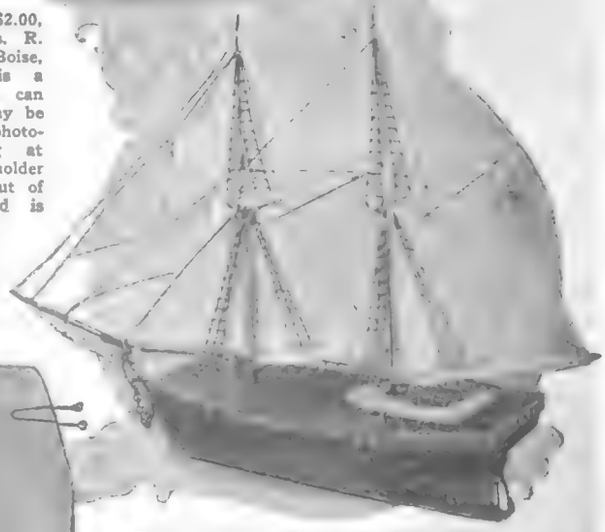




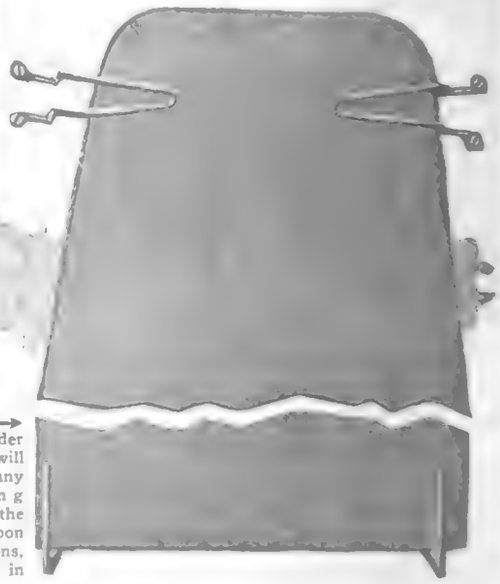
Third prize—$25.00, awarded to Mr. J. G. Dengler of Pittsburgh, Pa., for the wirekraft model of a lamp and flower basket which is shown in the above photograph. Miss Ann Reynolds is shown demonstrating lamp and flower basket. The lamp consists of a flashlight case with bulb. A very novel switching arrangement has been provided in the base of the lamp. The model is constructed entirely from wire which has been shaped very artistically. The upper part of the lamp may also serve as a flower basket, if so desired. The shade has a wire frame and is subsequently covered with silk. It is held in place by a small ship which is screwed on the top of the lamp adding to the artistic effect of the model.



Twelfth prize—$2.00, awarded to Mrs. R. B. Garside, Boise, Idaho. This is a scouring powder can holder which may be seen in the photograph appearing at the left. This holder is constructed out of heavy wire and is enameled white. The constructor has suggested that an advertisement be placed on the back.



Fourteenth prize—$2.00, awarded to Mr. E. Longinett, St. Louis, Mo., for the ironing-board holder shown at the left and also below.

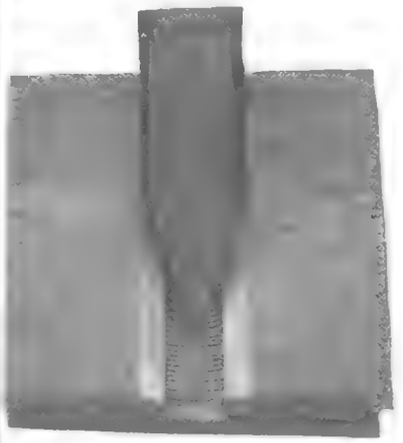


The thirteenth prize—$2.00, awarded to Mr. F. Rorkovich of Bridgeport, Ohio, for his wirekraft model of the lamp shown at the left. The base of the lamp is constructed of gold bronzed wire. The shade is made of square bus-bar wire and is lined with pink tissue paper. The shade rests upon the bulb and is thus held in place. The lamp is simple in construction yet its artistic value can not be denied.

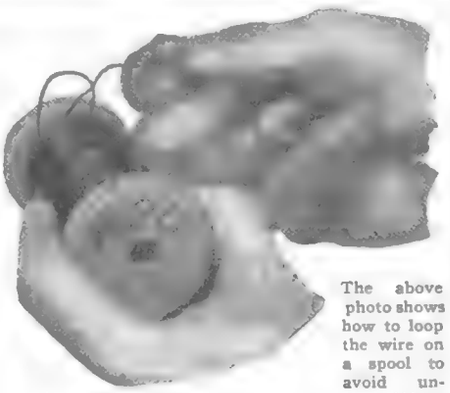
The ironing-board holder shown at the right will prove to be a boon to any housewife. The ironing board is slipped beneath the wire clips and rests upon two L-shaped projections, thus it is securely held in place.

FURTHER WIREKRAFT TECHNIQUE

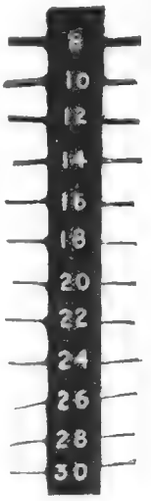
By RAYMOND B. WAILES

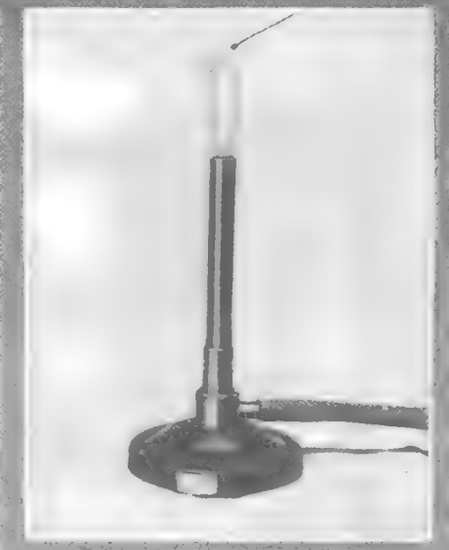


The above photograph shows how pancake-like coils of wire can be made and can be readily soldered for use in the construction of various wirekraft articles. A groove is hollowed in the top board to permit of application of the iron.

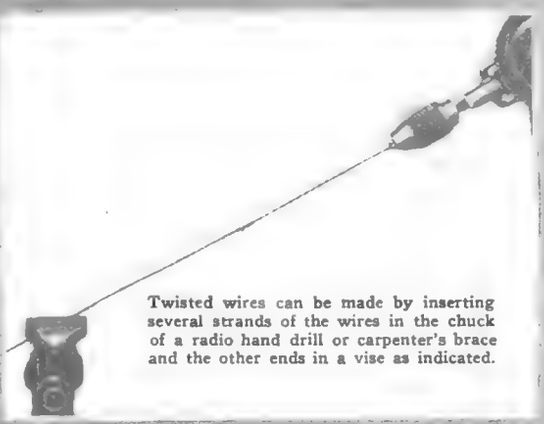


The above photo shows how to loop the wire on a spool to avoid unravelling. The photo at the left indicates how a simple wire gauge can be made.

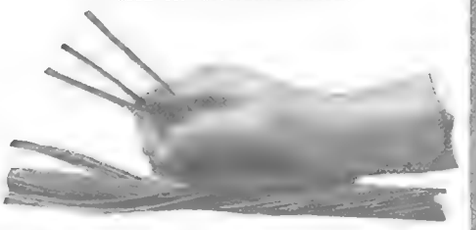




The photograph above shows how little beads can be made by holding a piece of copper or brass wire in the blue flame of a Bunsen burner. The melted wire forms a beadlike structure which can be clipped off and used for decorative effects.



Twisted wires can be made by inserting several strands of the wires in the chuck of a radio hand drill or carpenter's brace and the other ends in a vise as indicated.



Old electric cables afford vast quantities of large sized tinned copper wire. After the insulation is stripped off, the wire can be untwisted from the cable.

FLAT coils of copper, brass or tinned iron wire can be made quite readily by using the simple winding form as shown in the photograph. The two pieces of board are separated by a washer fastened through the center by a bolt. The wire is wound in the slot or space thus afforded between the boards and as one winds the wire around the washer, the wire naturally takes the form of a circle or coil. After the flat coil of wire has been formed, it is soldered along several portions. The forms when removed yield a nice flat spiral of wire which can be used for many decorative purposes in WIREKRAFT.

In decorative work on some piece of WIREKRAFT, little pendants of wire can often be used. To make such an item, one need only hold a copper or brass wire of the desired size in a blue flame whence the end will melt and roll up into a ball on the end of the wire. This little blobbed wire or pendant will not lose its bead when the stem is soldered to other parts. Two wires can also be welded together by this means.

Every *wirekrafter* should have a wire gauge. You can easily make one by mounting all the sizes of wire from No. 8 to No. 30—the sizes allowable in the contest—on a strip of wood and numbering each wire with its size. By referring a wire with an unknown size to the wires in the strip, one can readily determine the size of the wire in question. You can obtain short pieces of wire which are lacking from your stock from your friends.

Twisted wires will show off a wirekraft project very beautifully if used in the proper decorative place. You can make twisted wire by fastening the wires as shown.

HOW TO BECOME A WIREKRAFTER

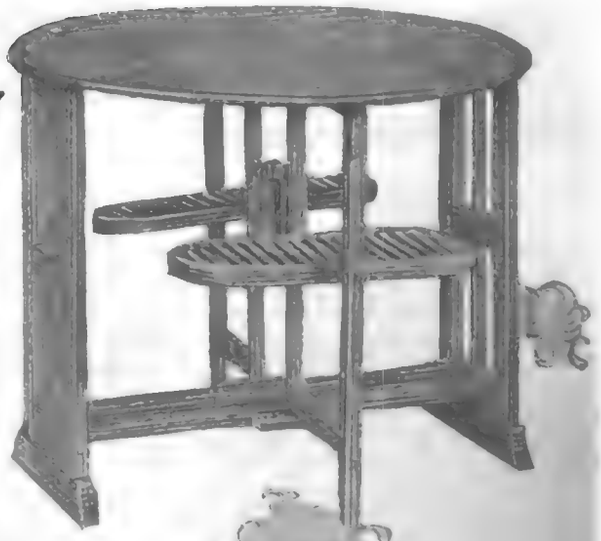
IT is quite easy to make articles of wire and to submit them in the $3,000 prize contest, the first group of awards of which are published in this issue. Every month for the next eleven months sixteen prizes will be awarded, the first of which will only be given to an article possessing utilitarian merits, an excellent example of which is the first prize-winning suggestion in this month's contest.

To those who are submitting entries in the Wirekraft Contest, we would like to give a word of caution.

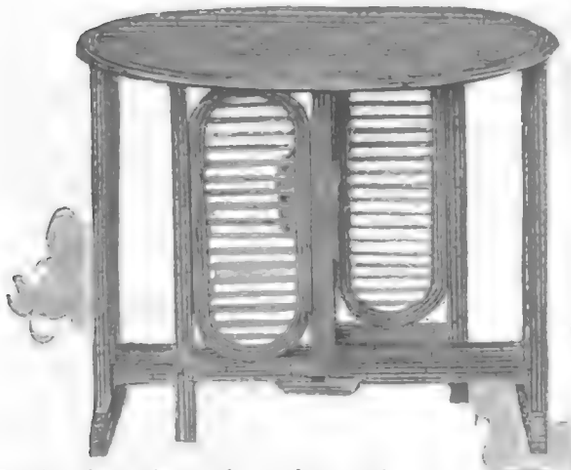
Many of the models are untagged when they arrive at these offices. Consequently, it is impossible to tell who is the designer. Before shipping your wirekraft model, please be sure that a tag is firmly affixed to the model and that this tag bears your name and address.

Those who would like further information pertaining to wire technique can obtain the desired data from the reprinted article originally appearing in the December issue of this publication which reprint will be mailed free of charge to those requesting the same. Simply address your communication to Editor, Wirekraft, care of SCIENCE AND INVENTION Magazine, 230 Fifth Ave., New York City.

MATCHCRAFT—
$100.00 in Prizes Monthly

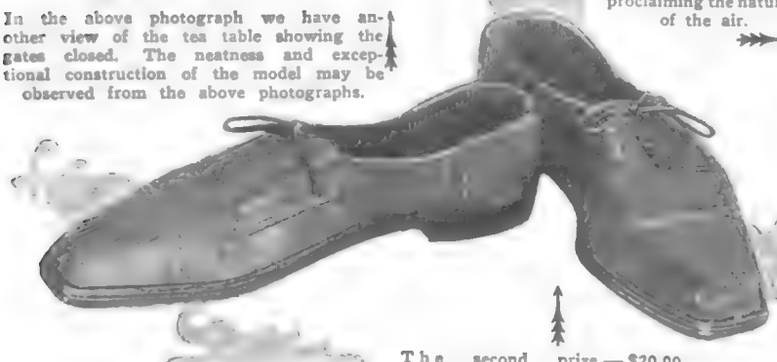


First prize—$50.00, awarded to Mr. Fred Spinden, Abingdon, Ill., for the matchcraft table shown in these two photographs. The photograph to the right shows this English gate-leg tea table with the legs or gates placed in open position. In order to make the top of the table the builder had to steam each match in order to bend it into position.



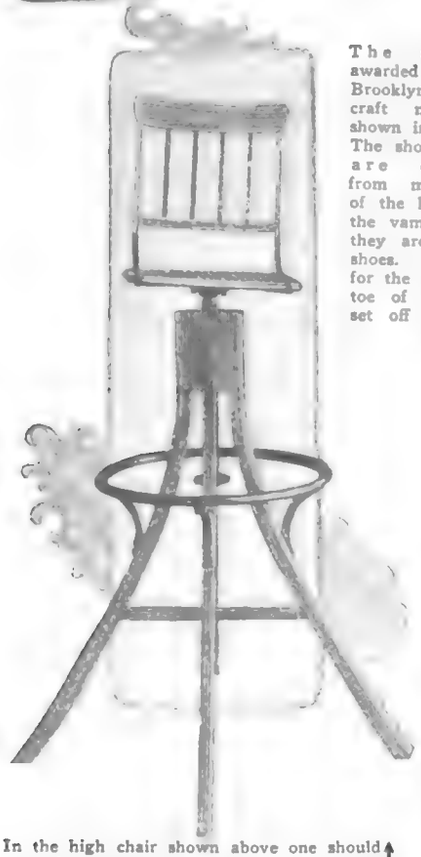
In the above photograph we have another view of the tea table showing the gates closed. The neatness and exceptional construction of the model may be observed from the above photographs.

The weatherhouse shown at the right is really a hygroscope. The cat-gut upon which the small images are suspended is affected by the humidity of the atmosphere. This causes one or the other of the images to come out of the house thereby proclaiming the nature of the air.



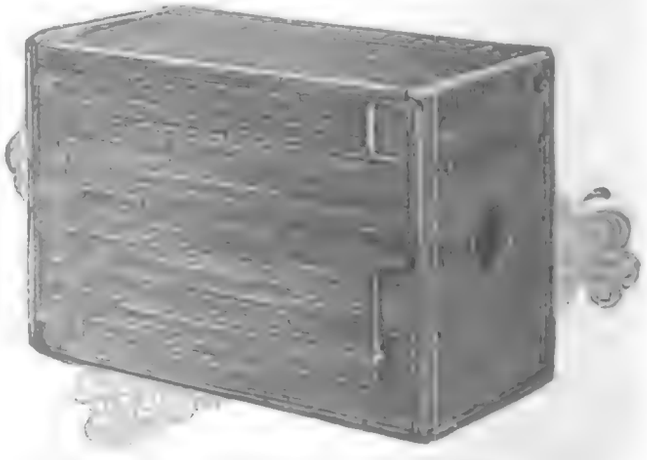
The second prize—$20.00, awarded to Mr. Irving Kline, Brooklyn, N. Y., for his matchcraft models of the shoes shown in the above photograph. The shoes are natural size and are completely constructed from matches with exception of the laces. The counter and the vamp are made exactly as they are in a pair of leather shoes. The shoes are shaped for the right and left feet. The toe of the shoe is artistically set off with a band of fancy match work.

Third prize—$10.00 has been awarded to Mr. S. F. Wotton, Friendship, Maine, for the model of the weatherhouse shown in the above photograph. The model is cleverly constructed and is useful as well as ornamental. Two small figures carved from matches are suspended on a cat-gut violin string. A small thermometer is also seen placed on the front of the house.



In the high chair shown above one should note the construction of the chair, particularly the number of curved pieces. Then one can readily appreciate the work required to make it. The swivel seat is especially worthy of attention. The spring and adjusting screw connected with the seat may be seen in the center.

Fourth prize—$10.00, was awarded to Mr. Fred Spinden of Abingdon, Illinois, for his matchcraft of the high chair shown in the photograph at the left. The seat is pivoted on a swivel and is free to turn in any direction. A cleverly arranged foot rest encircles the chair. The seat of the chair is constructed of matches in an imitation of a cane bottom. The high chair is very neatly constructed and makes a toy which any child would be glad to possess.



Fifth prize—$5.00, awarded to Mr. A. G. Mackubin of Chester, Pa., for the working model of the matchcraft camera shown above. A 2½x3½ film pack will fit conveniently into the rear of the camera. The camera is so constructed that either upright or lengthwise views may be taken. The front and the rear ends of the camera may be slid out of place at will. The shutter release and one of the view finders may be seen in the above picture.

Send in your models now. Rules of the contest appear on page 1174

Flashlight Aids Astronomy Instructors

THE illustration at the right shows a novel expedient adopted at the Lick Observatory, Mt. Hamilton, Calif., to point out constellations and individual stars for purposes of demonstration. A high-power concentrated-beam spotlight is used as a pointer, the finger of light being pointed directly toward the star being discussed. This device is of considerable assistance at the Observatory in lecture courses.—*Prof. Donald H. Menzel.*

High Visibility Tracer Bullet

A NEW tracer bullet, capable of etching a red line 1200 yards long in the skies, denoting the path of its flight, has been developed by the Ordnance Department of the Army, for use by machine gunners. Its most important function is that of facilitating correct aim, but in addition the new bullet is also incendiary in character, and especially effective against captive balloons, and other inflammable objects. The color effect is produced by a deflagrating chemical contained in the bullet and it was found that red was the most satisfactory, as it does not blend with the sky, and therefore gives a more clearly defined trace and this color has now been adopted as standard. The new bullet is loaded into ammunition belts for machine gun use in the proportion of one tracer bullet to five standard ball cartridges. The new bullet should be especially useful in aircraft warfare, where the estimation of range or direction is exceedingly difficult.

The Astrology Humbug

By JOSEPH H. KRAUS

Further Letters From Our Readers and Our Answers

ASTROLOGICAL FORECAST FOR 1927

Editor, SCIENCE AND INVENTION:

Have read your numerous articles on astrologers and of your rewards, regarding astrologer's predictions.

I believe your money is safe enough for personally I think astrology is "The Bunk." It is very interesting to read the ideas given by you and you sure have them up a tree most of the time.

I am enclosing a news (?) sheet from the Sensational Section of "Syracuse American" of Sunday, Dec. 26 issue. May I hear from you regarding your opinion of same?

I enjoy reading your magazine and you sure have the "dope" on your idea of "astrology." I would be willing to wager another $6,000.00 or $106,000.00 if I had it that no astrologer is able to foretell either by astrology (according to the stars or by any other way), three consecutive events —viz., when they will happen, where they will happen and what the events will be.

May I hear from you?

MILLARD J. CAMPBELL, Utica, N. Y.

*(In view of the fact that the predictions made by the astrologer (Belle Bart) in the particular article to which you allude are for events of the coming year, we would not be justified in commenting upon them. Needless to say, the astrologer has made no predictions of a nature which any conscientious thinking individual would not make. The predictions are for similar events as they were given for last year and the year before and undoubtedly as they will be next year. In the Readers' Forum more than one year ago this same writer made the prediction that several attempts would be made on Mussolini's life. The attempts were made, yet this writer is no seer. The article on astrology, to which you refer, also makes the same prediction. There is no reason for us to suppose that this is anything astounding. Repeated attempts have already been made on the remarkable Italian leader's life and undoubtedly they will be repeated. Mussolini is not living in a country where his proclamations are greeted with accord, by the population to the extent of 100%, and while fanatics exist, attempts on the life of the dictator will be made. What is so wonderful about the statement that "a general referendum will be held in the various states throughout the United States involving the Volstead Act." It has already been done in a great many states. We doubt if the referendum will take place in every state because there are some localities in this country which are bone-dry and will continue to be so. A bill for a referendum could not pass through the houses of these particular states. The statement therefore that "the way will be paved for revival of the actual use of light wines and beers in 1928" should be looked upon two ways. In the first place, the astrologer predicts nothing except the "paving of the way." She does not state that in the year 1928 we will have light wines and beers, neither does she say that the country will be dry. As a true astrologer, she makes statements which you can take either way and she will of course have to be correct, but they are not concrete examples and statements of this nature could never be used in the qualifying for the astrology prize. As a matter of fact, the road to modification of the Volstead Act has been paved, not all the way, it is true, but many of those newspapers which years ago came out strongly for prohibition have completely reversed their opinion and are now advocating anti-Volsteadism. The paper, a copy of which you included with your communication, is an outstanding example of this reversal of opinion. Statements concerning trouble with Mexico and also with Latin-America are likewise not phenomenal, particularly when one considers that vessels were ordered to Nicaragua (which fact is not mentioned in the horoscope) as early as August, 1926, long before the astrologer even wrote the article. And is there anything new in the Prince of Wales falling off his horse or Henry Ford extending himself as far as his activities are concerned or that the United States will not join the World Court in 1927 and that John D. Rockefeller, who will be 88 years old on July 8, will not enjoy the best of health? Ordinarily, we do not think that a man as active as Mr. Rockefeller had been, could be expected to enjoy the best of health. Fortunately for Mr. Rockefeller, his mode of living and his exercise in the open air buoys up his spirits and he shows the ability (and undoubtedly feels it) of a man much younger in years. We know many who are only 50 years of age and are not able to get about as well as Mr. Rockefeller. This same prediction was given last year and will be given next year and possibly the year after and Mr. Rockefeller will not change his mode of healthful living in spite of the astrologer's predictions.—*EDITOR.)*

$6,000.00
For Proofs of Astrology

SCIENCE AND INVENTION Magazine holds that there is nothing scientific in Astrology, that Astrology is not a science and that statements made by astrologers unless very general cannot be entertained seriously.

Accordingly, this publication has decided to award an Astrology Prize of $6,000 for the following:

$5,000 will be paid to the astrologer or forecaster who will foretell three major events of such a nature that he will have no control over the outcome of the same. He must describe in advance each event in detail, giving the location and result or the casualties if the event is an accident.

$1,000 will be paid to the astrologer or forecaster who will produce three accurate, detailed and perfect horoscopes, free of contradictions on the lives of three people whose initials will be given him when he requests the same and the birth dates and place of birth will also be supplied by this office.

This contest closes October 1st, 1927, and all entries must reach us by that time. In event of a tie, prizes of an identical nature will be given those so tying.

Address all entries to Editor, Astrology, care of SCIENCE AND INVENTION Magazine, 230 Fifth Avenue, New York, N. Y.

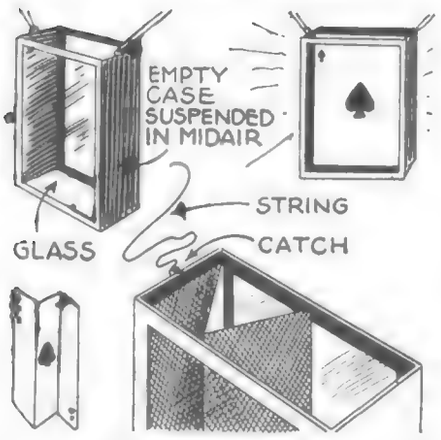
MAGIC By "DUNNINGER"

DUNNINGER
Joe Dunninger Tells How Prince Got Trick to Show Home Folks
HYPNOTIST RULES SUBJECT BY RADIO
Reads Mayor's Inner Mind

THE MAN WHO MYSTIFIED
Pres. Coolidge
Prince of Wales, Ex-President Harding, Taft, Roosevelt, and other celebrities
Writes Exclusively for
SCIENCE AND INVENTION

Folks Are Mystified Yet Delighted by This Man
Mind You! The Mind Reader Really Read the Mayor's Mind
Dunninger Will Attempt To Hypnotize Patient, 10 Miles Away, by Radio

The Crystal Houlette



In an empty crystal case suspended from two ribbons a card can be made to mysteriously appear after it has been caused to disappear. It will be observed that the card itself is folded at one end of the houlette.

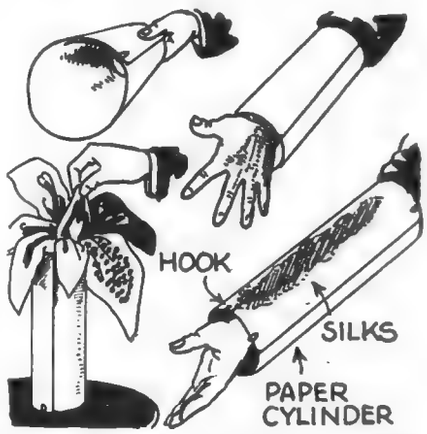
THIS is a new system for the reappearance of a previously chosen and vanished card. A deck of cards is seen in the case which is suspended by two ribbons and hangs in mid-air. The deck is removed and a card is chosen. This card is destroyed and placed in the magician's pistol, who fires at the now empty transparent case. The card magically makes its reappearance, completely restored in the box. The sides of the houlette are made of brass and front and back of the holder are of glass. The chosen card is forced upon the spectator and then destroyed. A duplicate card divided into three parts hinged together with pieces of rubber and concealed alongside of one of the sides is released when the string is pulled. A catch holds the folded card in place.

Second Sight Mystery

HERE is an impromptu trick which any amateur magician can present with an assistant and which requires no practice whatever. In the hands of a clever showman, the offering is little short of miraculous. The wizard sends the medium out of the room and during her absence, the spectators decide upon some object which is pointed out to the magician. Upon the magician's request, a committee asks the medium to re-enter. The magician then, without saying a word, points to many objects in the room and the moment the proper one is pointed out, the medium calls out that it is the selected article. The spectators can decide beforehand at what number the magician is to point to the object so that a count agreement between the wizard and his assistant is out of the question. Extension of the finger alongside of the wand is the code.

This is a very ingenious stunt and incidentally an excellent impromptu parlor trick in which the code to the medium is indicated by the manner in which the wand is held.

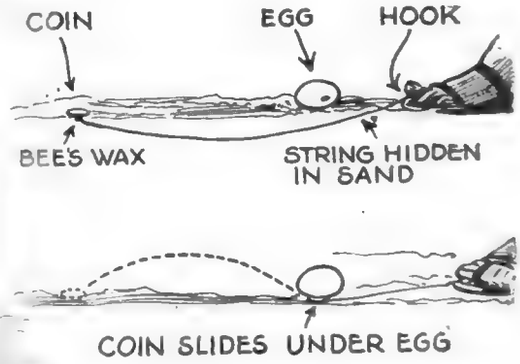
Silks From Nowhere



A sheet of cardboard is rolled into a cylinder and then held in position by means of paper clips. It is slipped upon the arm to show that it is empty, but on being removed is found to be full of silks.

HERE is an excellent magical diversion quite simple to perform. The wizard presents a large sheet of cardboard to his spectators for their examination. The inspection having been made, he rolls the cardboard into the cylinder which is held in this position by a number of paper clips. He proves the tube empty by looking through it and pushing his hand and arm into the cylinder. The tube is then placed on an undraped side stand, after which the magician bares his arms to his elbows and proceeds to withdraw many silk kerchiefs from the interior of the tube. The paper clips are then removed and the tube is unfolded, both sides of the paper being again shown. The silks are introduced into the tube via the coat sleeve as illustrated.

The Yogi Coin Illusion



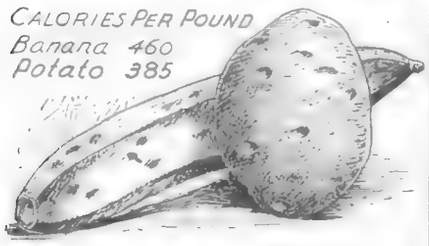
A Hindu fakir displays a coin and an egg. These are placed upon the ground. At the mystic's command the coin jumps from this position and secretes itself below the egg. The secret lies in the fact that a small black thread is tied to the toe, buried a fraction of an inch in the ground, and a pellet of wax is affixed to its far end. The coin is attached to the wax pellet. Moving the toe moves the coin.

Bananas a Nutritious Food

THE humble banana retains the distinction of being the only fruit immortalized in song. And that's about as much as the average person knows about it. The banana, however, has been used as a staple food in the tropics for many years, and its utility has been recognized to some extent in this country as a delicious but hardly nutritious food. The medical profession has expressed itself rather thoroughly recently on the dietary uses of the banana, and it will be of some interest to the layman to set forth some of the virtues of the fruit for his benefit. Unlike many fruits, the banana reaches the consumer in a germ-proof package sealed by Nature, herself. The thick enveloping skin effectively protects the edible portion from bacteria, moulds or other contaminations. Furthermore, the pulp is peculiarly immune from insect pests—a worm-eaten banana is unknown. Bananas are always harvested and shipped in the green state, and are ripened in specially constructed rooms, where it is possible to maintain the temperature and humidity necessary to develop the proper color, ripeness and flavor. It is one of the few fruits that reaches the highest perfection in food value and flavor when harvested green and allowed to ripen off the tree. One point in this connection that is often overlooked, is the fact that the banana is not really fit to eat raw until it begins to turn brown and dark spots appear on the skin. This change in color may be sometimes due to careless handling, which causes bruising, so the best index of its condition is the solidity of the pulp. It is not often realized that the banana may be cooked and served in a large number of very appetizing ways, and that it may also be used as a substitute for other less palatable foods. Bananas which are not ripe enough to be eaten raw may be baked or fried and served in a variety of delicious ways. If you have never tried bananas fried in butter, by all means make the experiment and introduce yourself to new delights of cuisine. Don't be afraid to feed bananas to the youngsters, so long as they—the bananas—are thoroughly ripe. The banana is not so constituted as to fully substitute for other articles of infant diet, but the fruit is so easily digested and assimilated that no harm can possibly result from a moderate indulgence. A glance at the illustration on the borders of this page will give you a graphic comparison of the banana with other more common foods. The accompanying illustrations represent a comparison of the energy value of the banana with other products, the energy value being expressed in calories per pound.

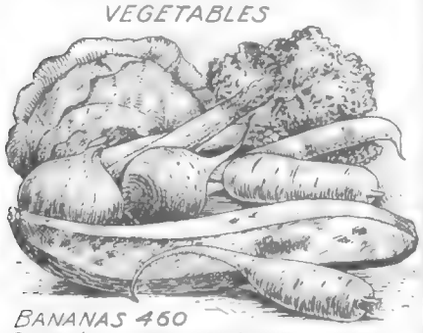
A COMPARISON OF THE EDIBLE PORTIONS OF BANANA AND POTATO

CALORIES PER POUND
Banana 460
Potato 385



	BANANA	POTATO
Water	75.3%	78.3%
Protein	1.3	2.2
Fat	0.6	0.1
Total Carbohydrates	22.0	18.4
Mineral Matter	0.8	1.0

ENERGY VALUE OF BANANA, EXPRESSED IN CALORIES PER POUND, COMPARED WITH VARIOUS VEGETABLES



BANANAS 460

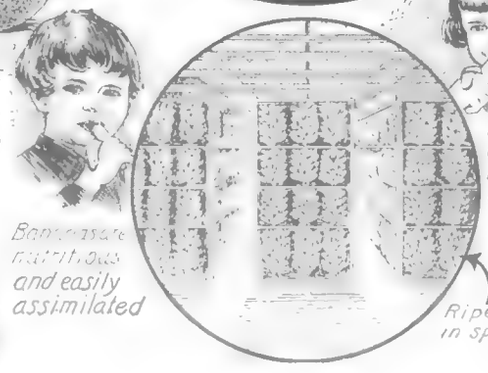
Parsnips	300	String Beans	195
Onions	225	Cabbage	145
Beets	215	Spinach	110
Carrots	210	Asparagus	105

ENERGY VALUE OF BANANA, EXPRESSED IN CALORIES PER POUND, COMPARED WITH VARIOUS FRUITS

BANANAS 460

Grapes	450	Apples	290
Cherries	365	Oranges	240

Bananas come in a germ-proof package sealed by Nature



Bananas are nutritious and easily assimilated

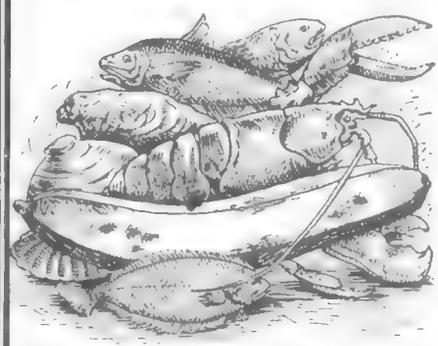
Ripening Bananas in specially constructed rooms

As food for children, ripe Bananas are especially good.

ENERGY VALUE OF BANANA, EXPRESSED IN CALORIES PER POUND, COMPARED WITH MILK AND CEREALS

BANANAS—460
Macaroni, cooked 415—Milk, whole 325
Oatmeal, boiled 285

ENERGY VALUE OF BANANA, EXPRESSED IN CALORIES PER POUND COMPARED WITH VARIOUS FISH



BANANAS	460	Bluefish	410
Lobster	390	Scallops	345
Haddock	335	Flounder	290
Clams, raw	240	Oysters	230

GRAMS PER 100 GRAMS EDIBLE SUBSTANCE IN BANANAS, APPLES, AND ORANGES.

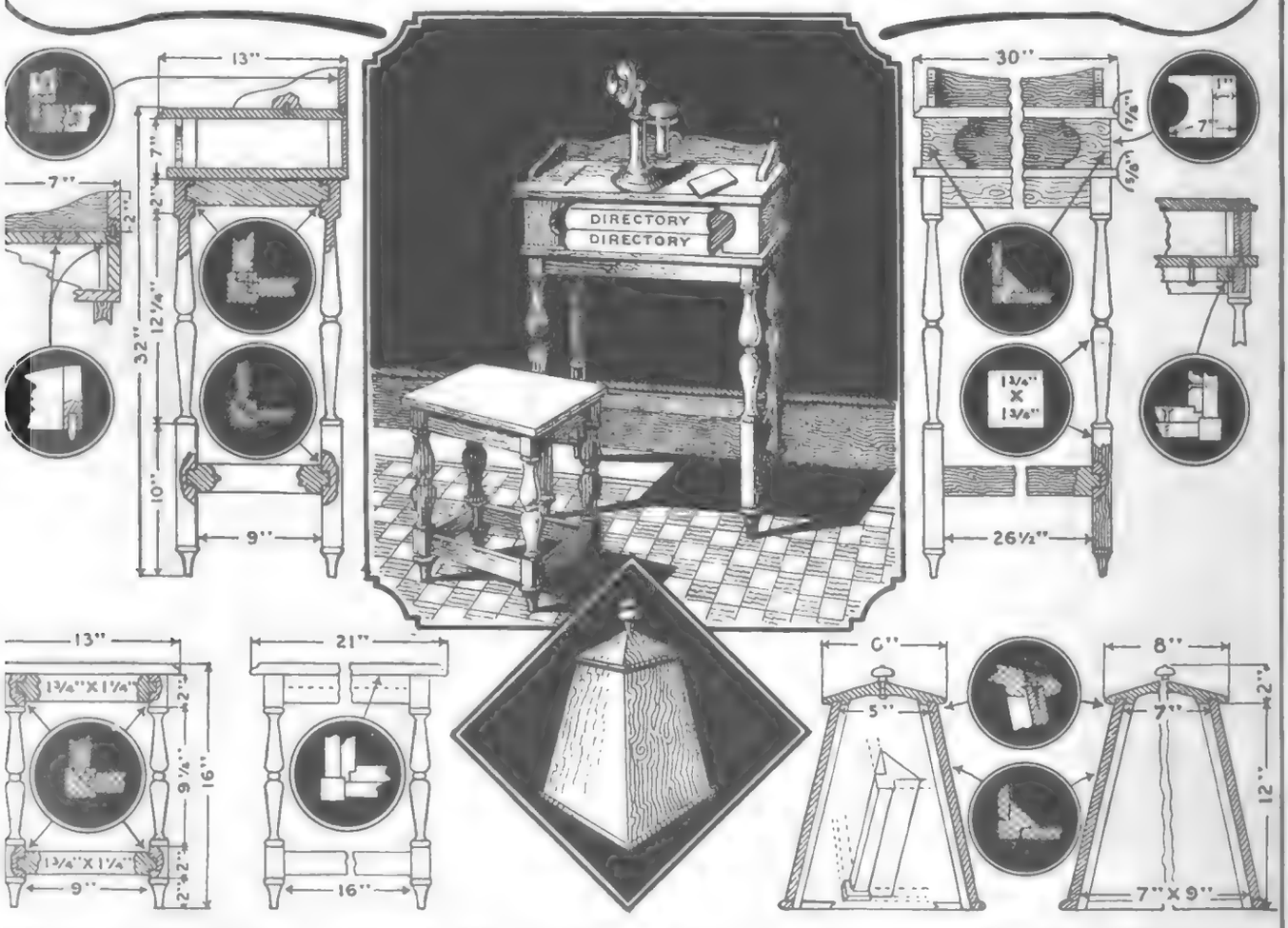
	PHOSPHOROUS	CALCIUM	IRON
BANANAS	0.031	0.009	0.0006
Apples	0.012	0.007	0.0003
Oranges	0.021	0.045	0.0002

CURLEY

Home Mechanics

Building a Telephone Desk and Stool

By W. M. BUTTERFIELD



The home craftsman will find it very interesting to build the telephone table and stool here illustrated in detail. The wood may be specially selected, or any stock that one has on hand.

The details of a wooden cover to be placed over the telephone when not in use are given directly above. This is optional with the builder. Further details of the telephone table are also given above.

TELEPHONE cabinets become a household necessity and are sold in most furniture stores. They range in price from $18 to $100 according to style, wood and finish. Although many sets shown are beautiful and decorative they are hardly useful, for there are no pieces of furniture so constantly in use or so roughly abused as the telephone cabinet. Consequently, decorations and finish can very well be ignored, particularly when durability and practical utility are represented in furniture less ornamental yet not altogether unsightly. In view of the above fact a style has been chosen which combines the ornamental furniture requirements with the greatest number of useful features possible for the home mechanic. The design and construction charts are also especially arranged for the home worker. The intent is to assist the worker to construct a set of "knock about" furniture that is sightly, useful and durable.

The cost of all materials, including mill work, such as turning the eight legs and gluing lumber for the seat top and two table tops, should not exceed $10. The sizes and amount of lumber, etc., required is as follows:

1 piece 62 inches long ½" by 2" lumber for back screen
2 pieces 31 inches long ⅞" by 7" lumber glued together for top.
1 piece 72 inches long ½" by 6½" lumber for directory enclosure.
2 pieces 31 inches long ⅝" by 7" lumber glued together for top.
1 piece 239 inches long 1¼" by 1⅞" lumber for rails on seat and table.
1 piece 125 inches long 1¼" by 1¼" lumber for fastening tops.
1 piece 30 inches long 1¼" by 1½" lumber for corner pieces.
1 piece 164 inches long 1¾" by 1¾" lumber for eight legs.
2 pieces 22 inches long ⅞" by 7" lumber glued together for seat top.
1 piece 50 inches long ¼" by 9¼" lumber for telephone screen.
1 piece 10 inches long 1½" by 8½" lumber for telephone screen top.
1 piece 50 inches long 1¼" by 1¼" lumber for corners in telephone screen.
1 piece 40 inches long ¼" by ½" lumber for rim on telephone screen.
8 3/16" screws 1¾" long for holding tops and directory enclosure together.
4 1⅛" screws ½" long for holding top on telephone screen.
16 3/16" screws 1⅞" long for holding top fastener
1 button (glass) for top of telephone screen (fastened with screw).

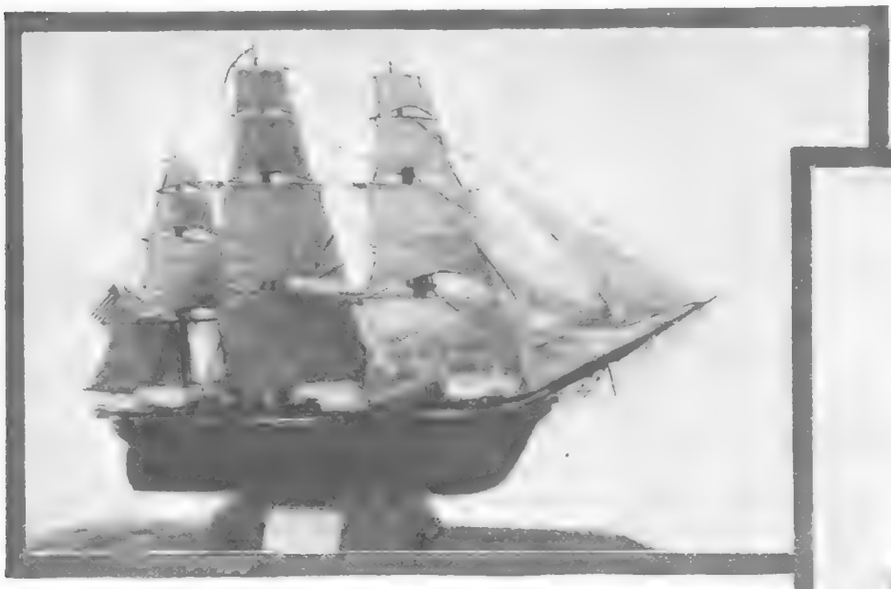
Oak or maple are perhaps the two best and most available woods to be used. It will be advisable for estimates to go directly to one or two of the local lumber yards, where mill work is done, for cabinet trim used by carpenters or builders. Make your "approach" by taking the mill man into your confidence, show him what you intend to do, ask his advice, and let him use his machinery wherever it can be used. You will be surprised how easy making a telephone cabinet is once you get his help. Professional cabinet-makers and builders do this every day with marvelous results. The mill man expects to be called on to advise and help his customers, so have no fear of doing something unusual.

Boards are glued together for table tops and shelves; legs, spindles, balusters, curtain poles and a hundred other things are turned; moulded edges are planed out on table tops, seat-tops, and the like; scroll work is sawed and even laid out by machinery; mortises and tenons made; and tongues and grooves run on lumber are a few everyday occurrences in lumber yard mills. Dowel sticks are sold by the hardware men. There is hardly anything of this kind done nowadays by hand.

If the home mechanic will make friends with some mill man, for he must remember he is asking, not bestowing, favors, he will find it much easier to make furniture than it is to earn money to buy it. And, if he is a

(Continued on Page 1161)

MODEL DEPARTMENT



The photograph at the left shows a view of the starboard beam of the U. S. S. Portsmouth; made by Fred J. Buenzle of San Francisco, Calif., which won this month's trophy cup. This is without a doubt, the most accurate miniature of a vessel which has ever been built.

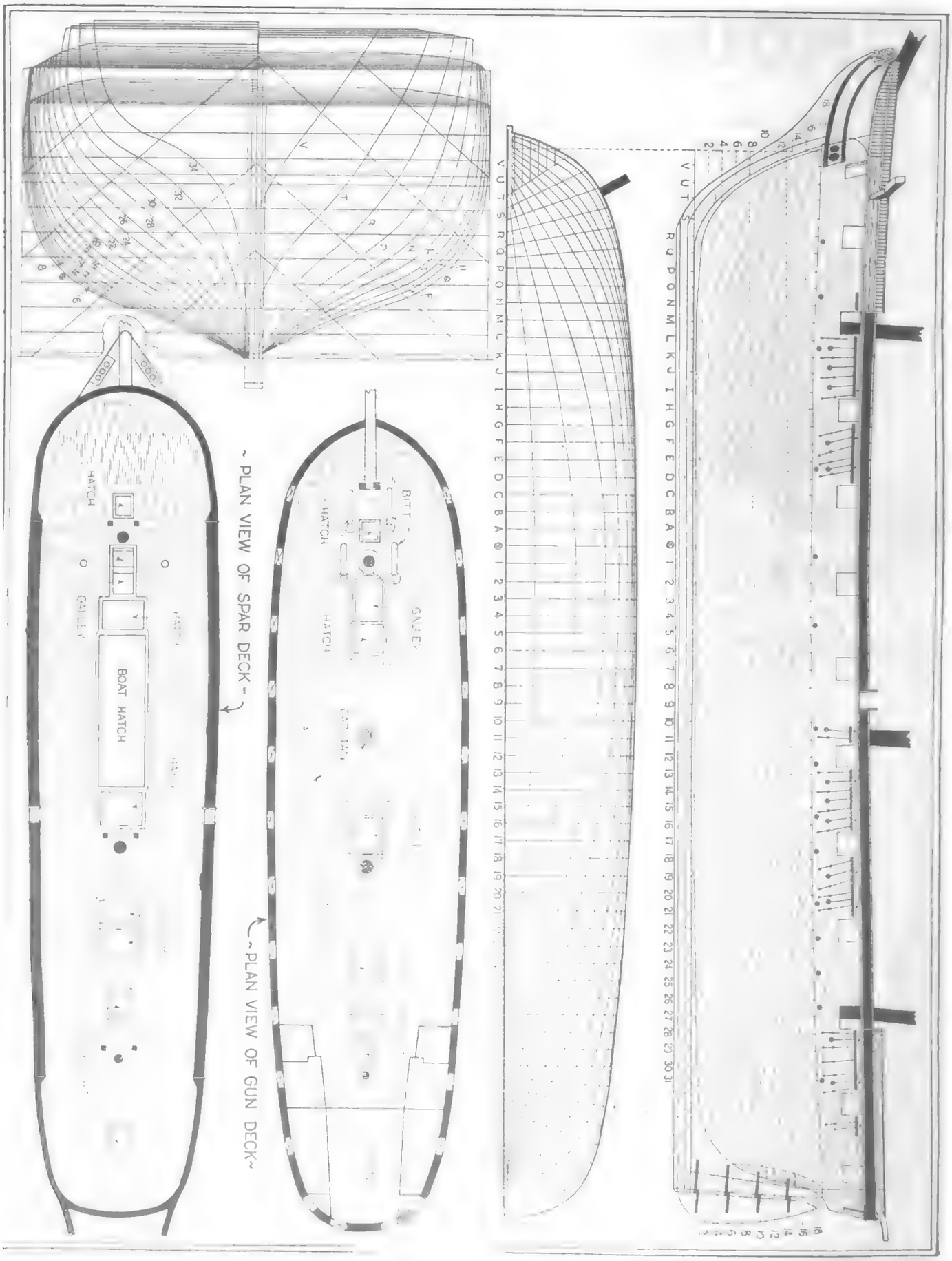
U. S. S. Portsmouth Built by Fred J. Buenzle, Wins Trophy

It is difficult to realize that one is looking down upon the deck of a model ship when one views the photograph above. On the weather side, hammock cloths have been rolled back showing 350 tiny hammocks rolled in regulation manner. Braces and tacks are carried down to deck and every sheet, clew line, reaf tackle, and other pieces of cordage are belayed and coiled away upon their respective pins.

The model of the U. S. S. Portsmouth which won this month's cup took more than a year of spare time to build. It faithfully follows the official blueprints of the old ship built in 1843. The flag contains 30 stars. The sailors' "dream sacks" are disposed inside the rail where they were used in combat as a protection against shot splinters. Originally this vessel had single topsails, but in 1889 she was the only U. S. Navy ship in commission with double topsails.

The photo at the left gives us another view of the prize-winning model. It will be observed that the vessel has only single topsails, whereas the drawings indicate the double topsails as the vessel appeared in 1889. Note the lightning rods. Right, the cup which was won in this month's contest by Fred J. Buenzle of San Francisco, Calif.

Hull Lines and Deck Plans of "Portsmouth"


~ PLAN VIEW OF SPAR DECK ~
~ PLAN VIEW OF GUN DECK ~
HATCH
BOAT HATCH
GALLEY
BITT
V U T S R Q P O N M L K J I H G F E D C B A @ 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

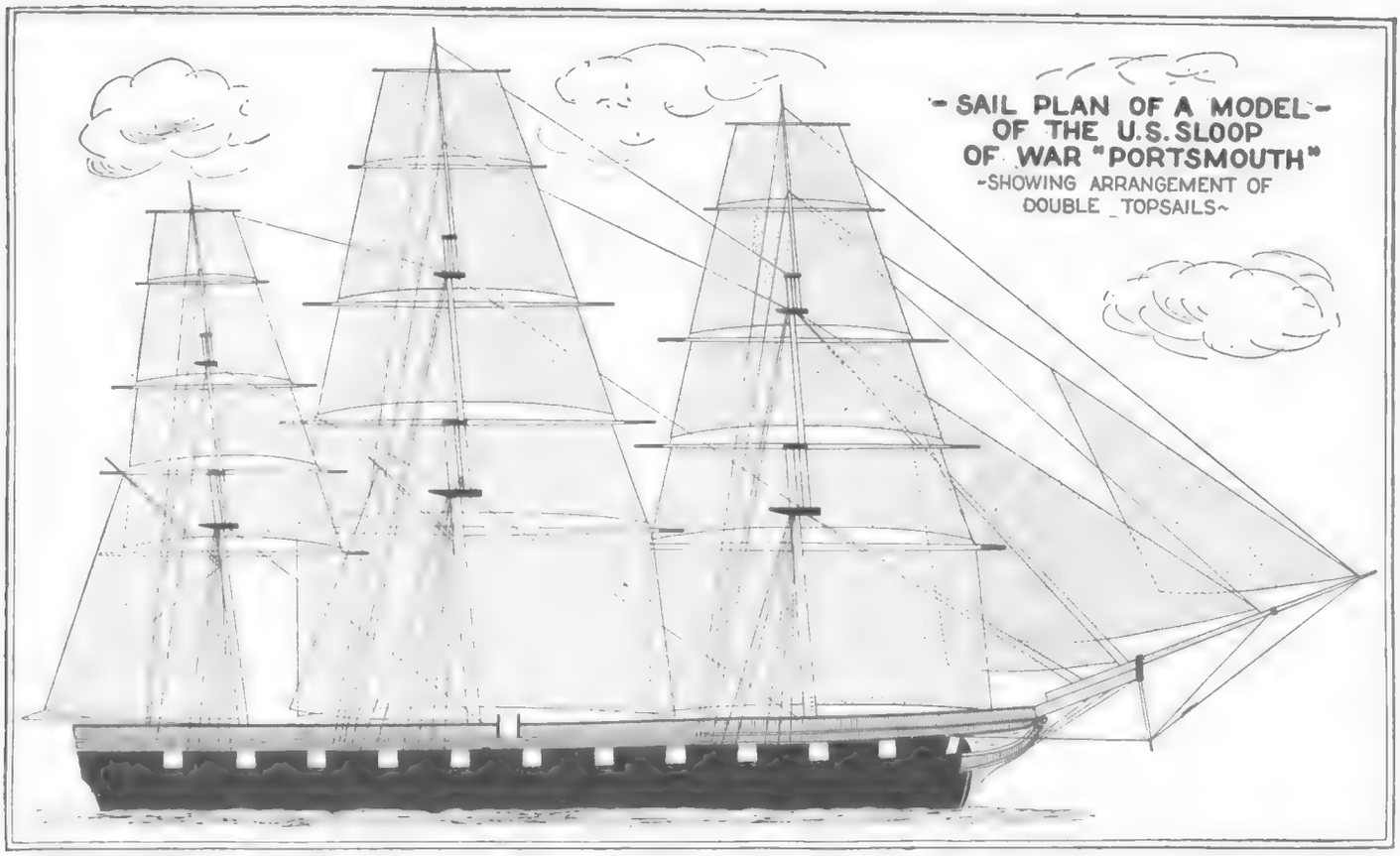
The above diagrams give us a view of the gun and spar de
Portsmouth and also indicate clearly the hull lines of '

Model '

he corresponding letters and numbers relate to the lines of the vessel.
The sail plan is given on the following page.

from the Model Department.

Sail Plan of Cup Winning Model



THE above diagram shows the sail plan of the U. S. Sloop of War, Portsmouth, with the arrangement of the double topsails as given on the official maps of this vessel for the year 1888. Previous to this the sloop had only a single top sail arrangement as is indicated in the photographs of the model, but for those who desire its newer arrangement, the drawings show its construction with double topsails. This sloop of war was registered as being 155¼ feet long, 28½ feet wide, 16½ feet deep and had a draught of 16½ feet forward and 17 feet, 5 inches aft. She carried 20,656 gallons of water and a total ballast of 42,458 pounds. The vessel was built in 1843 and was visited by Mr. Buenzle forty years ago when he enlisted as an apprentice in the United States Navy with a pay of less than $9.00 a month. This was the first vessel which thrilled the former Philadelphia boy and he has perpetuated his recollections of her in the model which won for him the much prized trophy which SCIENCE AND INVENTION Magazine is offering monthly for the best model entered during the month. The rules of the Model Contest are found on this page and it is suggested that all model enthusiasts enter this contest in competition for the cup. Any type of a model can be entered and it may be an airplane or a submarine, a Diesel engine or an electric motor. For further information we refer the reader to the rules in the first column on this page.

Rules for Model Contest

1. A handsome trophy cup engraved with your name, will be awarded as the prize for the best model submitted during the month. The decision of the judges will be final and will be based upon, A—novelty of construction; B—workmanship; C—operating efficiency of the model as related to the efficiency of the device which the model simulates, and D—the care exercised in design and in submitting to us sketches and other details covering the model.
2. Models of all kinds may be entered. They may be working models or not, according to the subject that is being handled.
3. Models may be made of any available material, preferably something that is cheap and easily obtainable. Models made of matches should not be submitted to this department but should go to our Matchcraft Contest Editor.
4. Models must be submitted in all cases. Good photographs are also highly desirable and where the maker does not desire the model to be taken apart, legible drawings with all dimensions covering parts that are not accessible must be submitted.
5. Models should be securely crated and protected against damage in shipment and sent to us by parcel post, express or freight, prepaid. Models will be returned when requested.
6. Models for entry in any particular contest must reach this office on or before the 25th of the third month preceding date of publication. For instance, models for the June contest must reach us on or before the 25th of March.
7. Address all entries to Editor Model Department, c/o Science and Invention Magazine, 230 Fifth Ave., New York City.

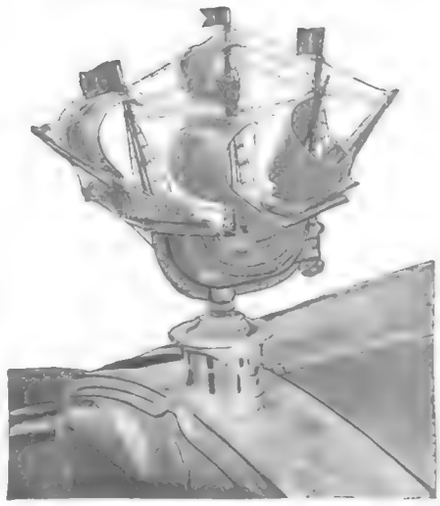
NEARLY a year ago SCIENCE AND INVENTION Magazine inaugurated a model contest in which a handsome trophy cup engraved with the winner's name was to be awarded monthly for the best model submitted during the month. Models of all kinds were requested and won cups when they were considered the best entered during the month. Among the models we find steam engines, a war vessel of the thirteenth century, an 880-ton bark, a gasoline-fired locomotive, a model of the U. S. Frigate "Constitution," a Chinese Junk, an electrically driven automobile, a model of a Roman ballista, a model of the "Santa Maria" and others.

Many other lucky model enthusiasts will win one of the cups which are to be awarded in the future. The conditions of the contest are simple. The model should be carefully wrapped or screwed in a strong packing case, should then be insured and forwarded to these offices. Our artists and draughtsmen do the rest. Our judges decide on the prizes and the model is then returned to its owner whether it wins the cup or not, and if it wins the cup, the cup is engraved and with its certificate of award is also forwarded to the prize winner. Inaccessible parts should be scaled up and sized to avoid the necessity of taking the model apart, but if this is done the work is done by experts who replace each part as it was found in the original model.

Don't hesitate—don't procrastinate.

If you have built a model send it in NOW.

Ship Model Adorns Car



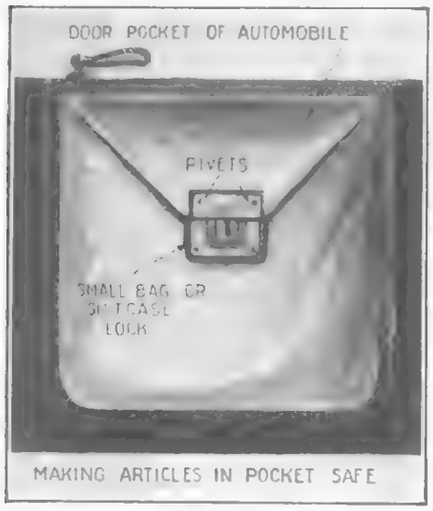
For uniqueness and originality of design we do not know of anything superior to the metal ship model which is seen in the photograph above and which adorns Clara J. Bierbower's car and is shown in the photograph above. It may be remembered by our readers that Mrs. Bierbower won the model cup awarded last month for her model of the "Santa Maria." What then is more fitting and proper than to have a replica of a historic vessel on the radiator of her car?

MOTOR HINTS

DO YOU KNOW, brakes are not so effective in wet weather, for the same reason that a wet hand will not grip a door knob.

LOCK FOR DOOR POCKET

Rifling the side pockets of automobiles, seems to be a prevalent sport among some children, and also among grown-ups, who are inclined to take things which do not belong to them.

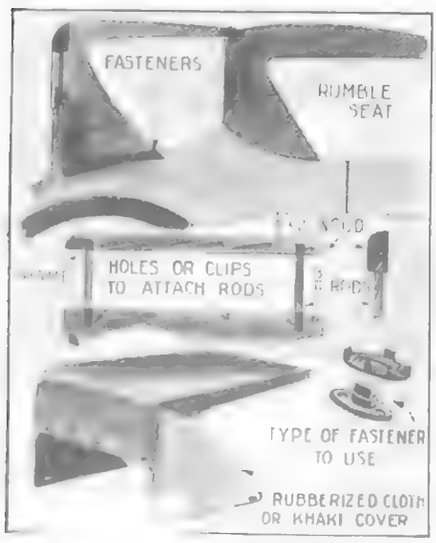


It is sometimes desirable to place a lock on the pocket found on automobile doors.

To prevent the minor articles being lifted from the side pockets of the car, one thoughtful motorist devised and put into practice the method shown in the attached sketch.

This consists of small snap lock fasteners, of the kind used on brief cases and traveling bags, riveted to the flap and the pocket.

These are snapped shut and fastened with a small key, making it necessary to have a key of the required size to open these readily.



…opy for the rumble seat, a …eedful accessory.

For usual purposes, one of these snaps on the driver's door, is sufficient to protect the numerous small articles, that the driver desires to retain. A suitable lock can be obtained from an old bag or even a suitcase, or better yet, the trunk and bag store will sell you one for a nominal sum. This same pocket provides a safe place for the operator's permit and for the registration ceritficate which accompanies the license plates.

CANOPY FOR THE RUMBLE SEAT

Roadsters with rumble seats for two extra passengers, are quite popular at the present time, but April showers are very discomforting to those occupying these seats. Of course the car owner may carry along a couple of slickers for these guests, but a better solution of the problem is the canopy of the simple type shown in the attached sketch, as made up by a roadster owner.

The full details shown in this drawing will enable any owner to equip a roadster in an hour or two of spare time, providing a demountable canopy, that folds and stows under the rear deck.

The construction comprises two vertical rods, placed in drilled holes or clips in the lid forming the rear seat back.

A cross bar of wood, is bored part way through with corresponding holes and rests on the vertical rods.

The cover is made from either rubberized cloth or khaki, being sewed and fitted with eyelets.

Turn-fasteners are attached to the rear edge of the top, to the seat back and under the edges of the sides of the seat.

This cover is tacked with brass or copper nails or tacks to the cross support and can be rolled up on this while the rods are simply slipped out of the holes.

This canopy should preferably be made of material to harmonize with the top, and it will form a neat fitting that is serviceable and practical.

IMPROVING THE BATTERY TERMINALS

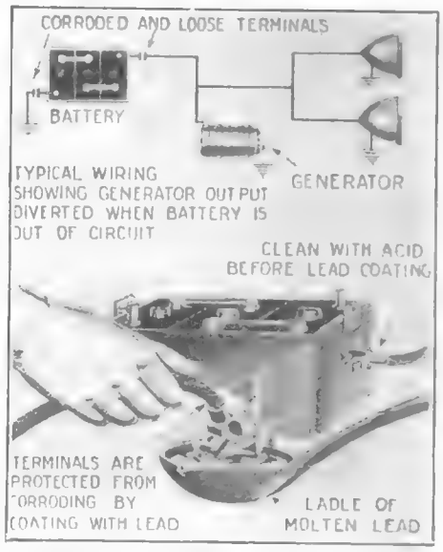
The owner of a car has possibly experienced at some time, the difficulty of keeping light bulbs from burning out. If repaired by an electrical service station, the owner obtains practically no information on the reason for this trouble, however the cause is simple and readily overcome by the owner if the reason is known.

In the appended illustration a typical wiring diagram is shown, and from this it will be clear that with a disconnected battery, the full generator output is put into the light bulbs. Inasmuch as the battery, when connected, absorbs the excess current, the disconnection of the battery, results in the bulbs being subject to the excess and the filaments break down under this load.

The ground connection is one of the offenders, this connection being frequently broken because of being short and unable to hold if the battery is loose in the fastenings. The remedy is to secure the battery solid and use a flexible connection with fair slack wire. A worse offender is that of corroded terminals. Either terminal may be corroded and cause intermittent contact.

These terminals are invariably brass and the sulphuric acid from the battery results in rapid corrosion. To avoid this, one of the most desirable remedies, is to tin or lead coat these terminals and prevent acid corrosion.

The sketch shows this process, consisting of cleaning the terminals with soldering acid and then dipping them in molten lead. Terminals thus tinned are made acid-proof and trouble-proof.


CORRODED AND LOOSE TERMINALS
BATTERY
GENERATOR
TYPICAL WIRING SHOWING GENERATOR OUTPUT DIVERTED WHEN BATTERY IS OUT OF CIRCUIT
CLEAN WITH ACID BEFORE LEAD COATING
TERMINALS ARE PROTECTED FROM CORRODING BY COATING WITH LEAD
LADLE OF MOLTEN LEAD

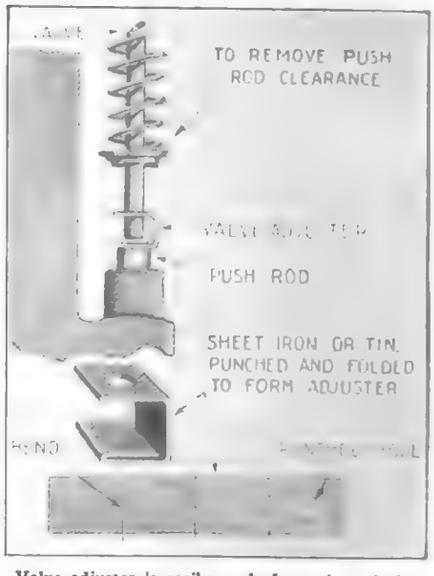
Improving storage battery terminals by dipping them in molten lead.

VALVE ADJUSTERS FROM TIN

It is always a problem in the case of engines having non-adjustable valve stems of the Ford type, to take out the clearance of the valve, without applying some special device which is hard to secure.

Use strips of tin, punched at one end to pass over the valve stem and double up the opposite end, in as many thicknesses as is required to take up the clearance.

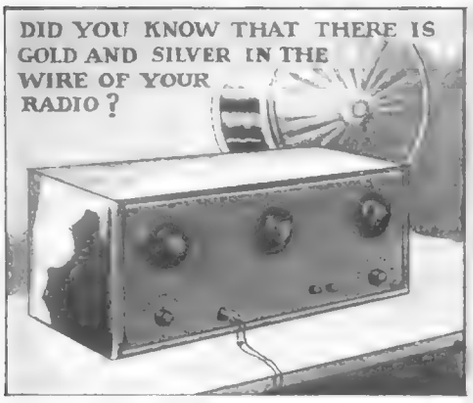
These are simply slipped in place, pushing up the valve momentarily, and when installed the clatter of valve stem clearance is eliminated in the running of the engine.



Valve adjuster is easily made from tin strip in the manner illustrated above.

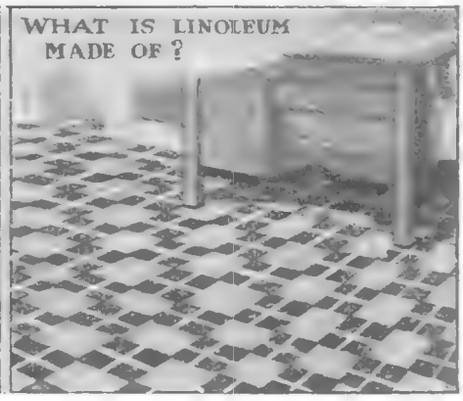
Everyday Chemistry

By RAYMOND B. WAILES

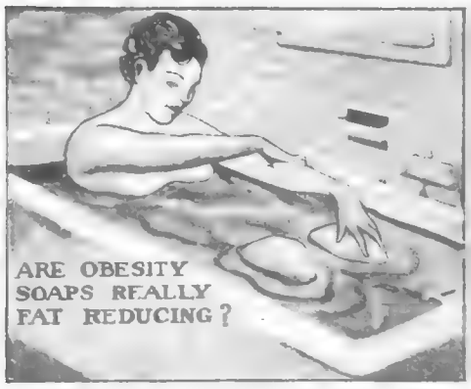


The copper wire in radio sets is practically pure, but almost all of it contains about .5 lb. of silver and .01 oz. of gold in every ton.

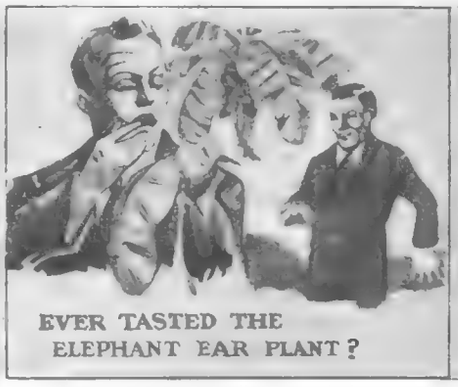
Clupanodonic acid is the substance which gives fish oils and products their taste and odor. The name is as bad as the substance.



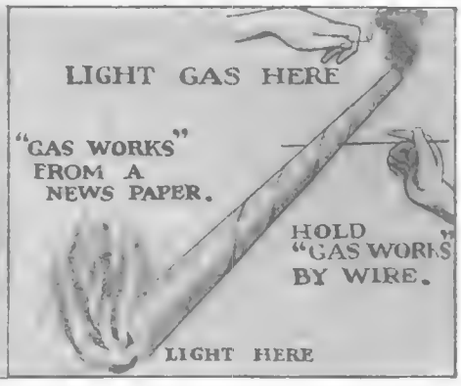
Linoleum is made by treating cork with linseed oil. The scum which forms on open paint cans is of a similar nature.



Reducing soaps contain potassium iodide, which is believed by some to be absorbed by the skin and rid it of fat. Physicians disagree.

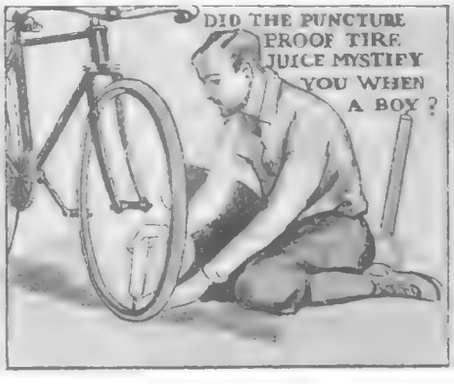


The burning taste of some plants is due to needle-like crystals of calcium oxalate which penetrate the mucous membrane.

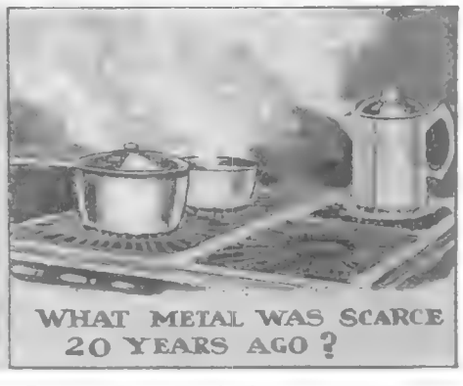


Combustible gases are formed, some of which are not ignited. The unignited gases will burn at the open end if lighted there.

These excellent floors are made from magnesium oxide and chloride—chemicals which are related to the common citrate of magnesia.

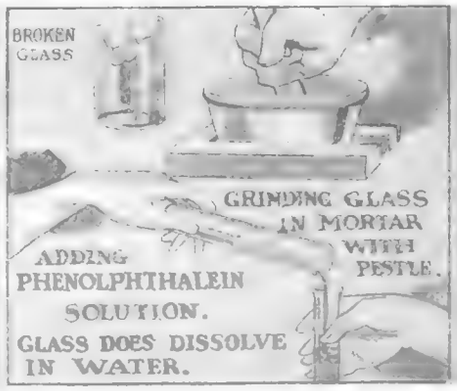


These fluids are made of glycerine, water glass, and an acid. A jelly-like precipitate is formed which mends the puncture.

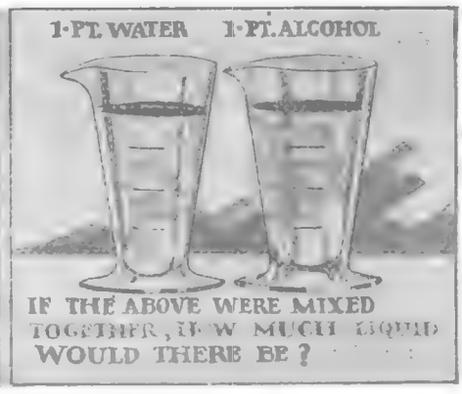


Twenty years ago aluminum was comparatively rare, due to the fact that the methods used to extract it from its ores were expensive.

Christmas tree snow is made of small particles of mica, a mineral substance which is extensively used as an electrical insulator.



Glass may be caused to dissolve in water by treating it as indicated above. Red color shows glass has been dissolved by water.



The mixture will not total a quart. Alcohol and water when mixed suffer a volumetric decrease due to intermolecular displacement.

Experiments In Organic Chemistry

By RAYMOND B. WAILES

THE experimenter should not think because he at first worked mostly with experiments in inorganic chemistry, that organic chemistry experiments should remain forever taboo. There should be no reason for this, for many of the experiments and preparations of organic chemistry are as fascinating to perform and to

Fig. 1. Absorbing ethylene from illuminating gas by combining it with concentrated sulphuric acid, the absorption being indicated by water rising in the tube on the right.

make as the same are in inorganic chemistry. To show the possibilities of this branch, the writer shows here some simple pieces of apparatus, which are especially adapted to organic chemical experiments, such as tests, analysis, preparations, etc.

To show that ethylene, C_2H_4, a gas burning with a yellow flame is actually present in illuminating gas the arrangement shown in Fig. 1 is used. Any size bottle will do. Illuminating gas is led into the long L tube from a gas fixture and allowed to fill the

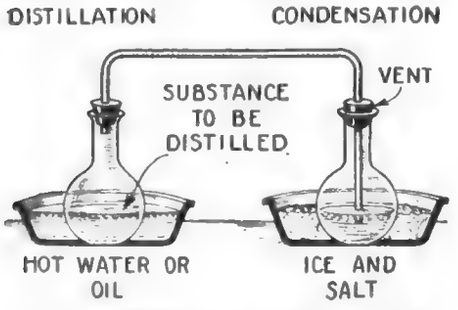


Fig. 2. Distillation of a volatile solvent from its solute. The illustration explains itself where strong refrigeration condenses the evolved vapors.

bottle, and then to escape by way of the tube on the right, issuing from its open end as bubbles, the end of the tube dipping into a beaker or dish of water. The separatory funnel should contain strong sulphuric acid. Dilute acid will not serve. After about a minute's passage of the gas the bottle will have become completely filled with gas. The gas cock or clamp should now be closed and the strong sulphuric acid allowed to enter into the bottle a drop at a time. As little as five cc of the acid are sufficient. Soon the acid will become dark colored owing to its combining chemically with the ethylene in the gas forming ethylene-sulphuric acid. A contraction takes place here and the water in the beaker will be seen to rise up into the tube on the right and then enter the bottle. Actually, the sulphuric acid chemically absorbs the ethylene in the gas.

Ether, alcohol, and carbon disulphide are frequently used to extract ingredients from mixtures. For instance, the amount of butter fat in a sample of butter can be determined by shaking the butter, freed from its moisture with ether, removing the ethereal solution and evaporating it, which leaves the butter fat in the vessel. A simple "apparatus" for the distillation of a volatile solvent from its solute is shown in an illustration. The solution is placed in a flask heated by warm water or hot oil, and the second flask to which it is connected is immersed in ice and salt or cold water. The second flask carries a stopper which has a small slit in the side to equalize the pressure within the apparatus with that of the atmosphere. The substance then distills over into the cold flask, which acts as a condenser.

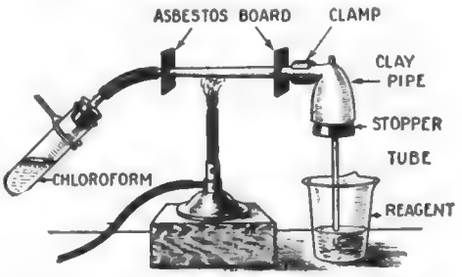


Fig. 3. Producing chlorine from chloroform by heating it as its vapor is passed through a clay tobacco pipe.

A test tube is fitted with a single hole stopper carrying a bent glass tube. This tube connects to the mouth end of a clay pipe, by means of a short length of red rubber tubing. Red rubber tubing will stand a higher temperature than will white or black. The bowl of the pipe is fitted with a stopper carrying a length of glass tubing, which dips into a solution of potassium iodide. The chloroform in the test tube is heated to boiling and at the same time another Bunsen burner is applied to the stem of the pipe so that it will be heated to redness. Two discs of asbestos board placed as shown will prevent the heat from destroying the stoppers. The chloroform vapor will pass through the red hot tube and be decomposed, forming chlorine, which will pass out through the exit tube and bubble through the potassium iodide solution, discoloring it almost immediately, due to the separation of iodine which the chlorine releases from combination with the potassium, forming potassium chloride as a by-product. Several drops of starch solution now added to the solution of iodine in the potassium iodide by-product will turn the solution a deep blue, and if there is much iodine present, the color will be black instead of blue. Add a very little starch.

Many organic compounds are purified by sublimation. Napthalene, sold commercially as moth balls, is an instance of a commercial product purified in this manner. As an illustration of the process of sublimation, mix some sand with powdered moth balls, grinding both together in a mortar. The

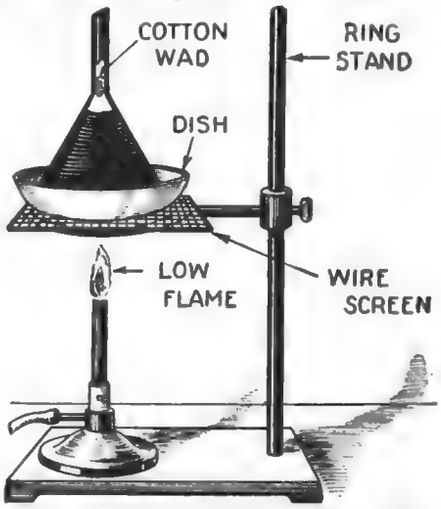


Fig. 4. Heating a mixture of sand and naphthalene (moth balls) in a funnel inverted over a dish, the sand remains and the naphthalene vaporizes and condenses in the funnel, in beautiful white scales.

two substances could be separated from each other by means of a selective solvent, which would dissolve the napthalene and leave the sand behind. Ether could in this instance be used, it dissolving the napthalene and leaving the sand. On pouring off the ether and evaporating or distilling, the napthalene will be left behind.

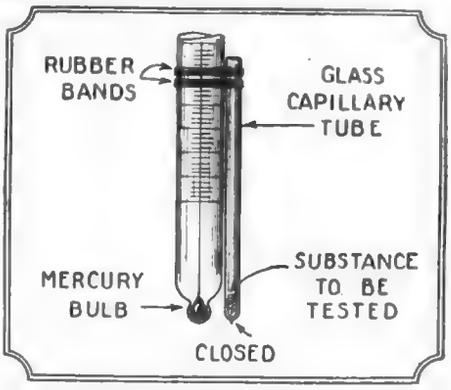


Fig. 5. Testing the fusion point of a substance by a simple yet approximately accurate method which may be available for many applications in the laboratory.

Place the mixture of napthalene and sand in an evaporating dish and invert a funnel over it with a small plug of cotton in the stem. Now gently heat the mixture. The napthalene will vaporize and condense in the funnel in the form of pearly white scales, being now chemically pure. They can be removed, bottled and labelled, "C. P. Napthalene." Impure anthracene can also be sublimed in this manner.

But how pure is the napthalene? A physical test can be applied to the sublimation product and to a host of other organic compounds. It is the determination of the melting point. Pure chemical substances melt at definite temperatures. The presence of impurities changes the melting point and if an accurate thermometer is used, the presence of impurities can be ascertained.

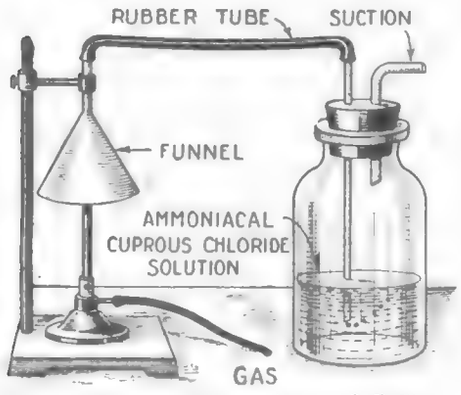


Fig. 6. An interesting experiment. Ordinary illuminating gas is made to produce acetylene by imperfect combustion and its presence is shown by its action on cuprous chloride solution, giving a red precipitate, Cu_2O.

Heat a glass tube until it softens and then draw it out into a fine thread about a sixteenth of an inch in diameter. Break off a 1½" length and close one end in the flame. Fill this tube with the substance to be tested for melting point, napthalene, sulphur, etc. This can be done by inverting this little melting point tube and inserting it, open end downwards, into the *powdered* substance to be tested. Ultimately the solid will work its way in. Now affix this tube by means of a rubber band to the stem of a chemical thermometer and immerse the bulb and end of the tube in strong sulphuric acid, or a clear oil such as Nujol. Do not allow the rubber band to come into contact with the liquid. Slowly heat the acid to a high temperature and watch the substance in the closed tube. The second it becomes liquid note the thermometer reading. This will be the melting point, which for napthalene is 218° Cent. If it is several degrees off, the thermometer may be wrong or the substance contains impurities. The sulphuric acid can still be used for other purposes.

Acetylene is an organic gas and is one of the products of incomplete combustion formed when a Bunsen burner strikes back and burns at the base. Light a Bunsen burner at the base and suck the issuing gases through a solution of cuprous chloride made ammoniacal, or alkaline, with ammonium hydroxide. A red precipitate of cuprous acetylide indicates the presence of acetylene. The cuprous chloride can be made by dissolving the solid in a dilute solution of hydrochloric acid and adding ammonium hydroxide.

The use of an air condenser is shown in the preparation of nitrobenzene from benzene. Add gradually, 100 grams of nitric acid to 150 grams of strong sulphuric, adding a little at a time, giving time for cooling. Now to the cold mixture add 50 grams of benzene with constant shaking and cooling by immersion in ice water. Place the mixture in a flask and put the flask into a water bath and heat the water to not over 60° Cent. (140° F.), determined by placing a thermometer in the water. Attach a 2- or 3-foot length of glass tubing having an inside diameter of about ¼" to the flask and in an upright position. This tube will serve as an air condenser. Heat for an hour. Cool and separate the upper layer of nitrobenzene from the lower acid mixture by means of a separatory funnel. Now add water to the nitrobenzene and shake. The nitrobenzene which had floated on the acid

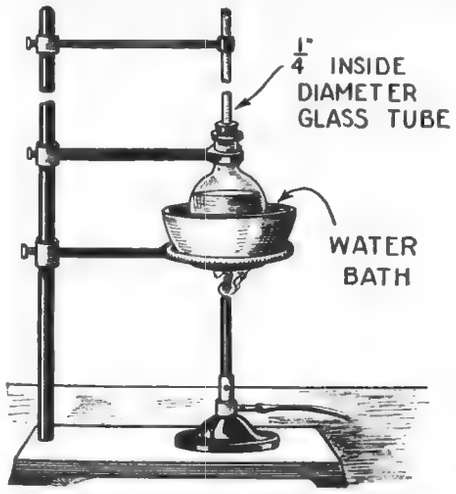


Fig. 7. A long tube, as indicated in the illustration, acts as an air condenser in an experiment with nitrobenzene.

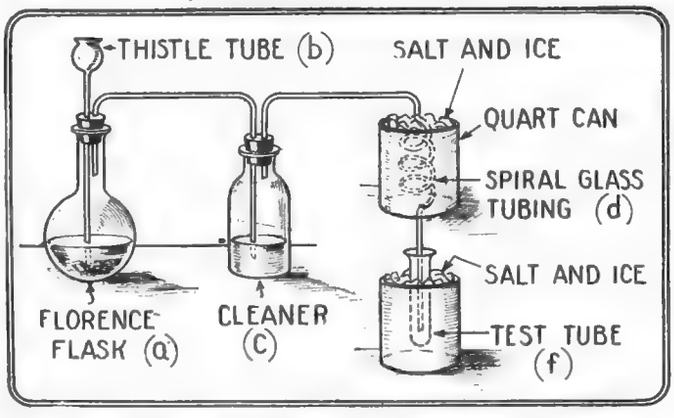
mixture, is heavier than water and is now the *lower layer*. Wash in this manner several times. Now distill the nitrobenzene after removing the water layer. The water serves to wash out any remaining acids. The nitric acid does the actual nitrating of the benzene, the strong sulphuric acid merely serves to absorb the water which is formed in the nitrating reaction.

The Preparation and Liquefaction of Sulphur Dioxide

By WILLIAM L. LUNDBERG

MANY experimenters have wished to study the properties of gases in their natural and liquid states, but due to expensive apparatus this has not been practical. I have found a very inexpensive way of preparing and liquefying sulphur dioxide.

The first step in the preparation of sulphur dioxide is to place a few grams of copper turnings into a small Florence flask, (a), and then cover the turnings with concentrated sulphuric acid (H_2SO_4). The acid is admitted to the flask by means of a thistle tube (b). The action of the acid on the copper produces sulphur dioxide, and this gas is then cleaned by passing it over to the bottle (c), in which there is about 75 cc. of concentrated sulphuric acid. Next the gas is run through the spiral glass tubing (d), which is inclosed in a quart vessel, and surrounded by salt and ice. When the sulphur dioxide reaches the end of the tubing, the gas is condensed into the liquid form, and is collected in the test tube (f), which is inclosed in a quart can, and is surrounded by salt and ice.



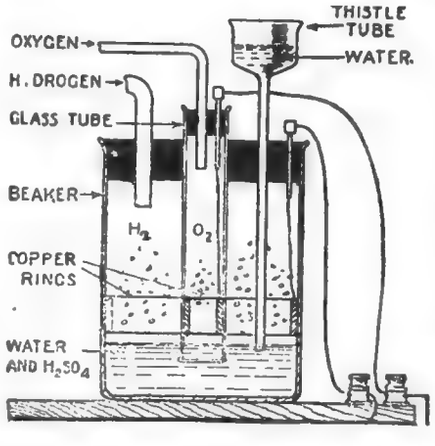
Sulphur dioxide is generated in the Florence flask, a, the gas is washed in the bottle, C, it is liquified by cold produced by salt and ice surrounding the spiral tube, d, and collects in the test tube, f, also surrounded with salt and ice.

Care should be taken to see that the ends of the thistle tube (a), and the delivery tube to the wash bottle, (c), are well below the surface of the liquid.

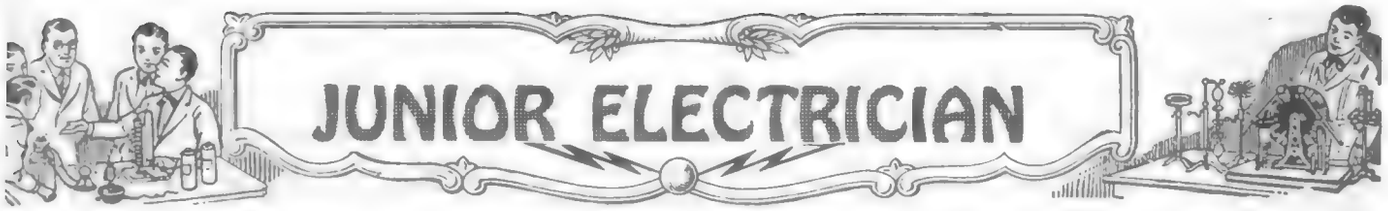
The liquid sulphur dioxide can be used in many interesting experiments.

Electrolysis of Water

WE illustrate a very interesting and ingenious apparatus for the electrolysis of water and the collection of the two gases, hydrogen and oxygen, each from its own evolution tube. A beaker with a tight stopper for its mouth is shown. As it may not be easy to get an adequate stopper which would best be made of India rubber for a beaker, a Mason jar may be substituted. Plaster of Paris could be used for the stopper, except for the fact that it expands as it sets and will almost infallibly crack the jar, but there should be no trouble in improvising a tight stopper, using a large cork boiled in paraffin wax. The illustration clearly shows the principle. One wire connects with what may be a carbon electrode in the outer vessel. In the inner tube marked with the letter O for oxygen, there is a second electrode. The jar contains sulphuric acid diluted with two or three times its volume of water. On passing a current through the sulphuric acid, oxygen will be liberated within the central tube and hydrogen will escape from the vessel outside such tube. One evolution tube connects to the outer vessel and the other to the central tube. A thistle tube is provided for adding more water as needed, and it also acts as a sort of safety valve. This makes an extremely nice apparatus and the gases may be used for various experiments.



In this apparatus water is electrolyzed and the constituent gases are delivered through two separate outlet tubes, for double the volume of hydrogen is produced as compared to the oxygen evolved. A large evolution tube is provided for it and for its companion gas, although this refinement is hardly necessary. Bits of carbon will serve as the electrodes.

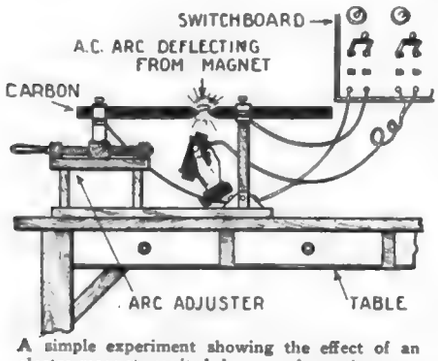


Experiment With an Arc

By ROBERT L. LEWIS

The following is an account of an experiment which I made.

An open adjustable arc is constructed to operate on 110 A.C. with suitable resistance as shown. If an alternating current magnet is held below the arc while in operation, a very loud noise is heard and the arc is "blown" away from the magnet



A simple experiment showing the effect of an electro-magnet excited by an alternating current upon the voltaic arc, the latter also being of the A.C. type.

making a hot torch. If a permanent magnet is used the arc is attracted to one pole and repelled by the other. If a strong direct current magnet is held to the arc a loud sputtering hiss is heard and the arc is again repelled.

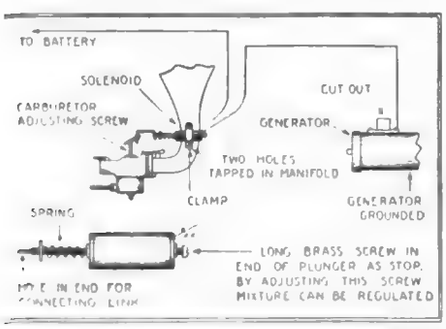
Colored glasses must be worn to save the eyes.

Electric Mixture Regulator for Motor

By THOMAS McCARTIE

The drawing shows a device which I use on my car. I have found that this device facilitates starting up, and allows the car to throttle down better in slow-moving traffic.

The solenoid is connected in series with the wire running to the battery. In most cars the circuit between the generator and the battery is not closed until the car is making over ten miles per hour, as no current is flowing through the solenoid when the car is going less than 10 miles per hour, the



A valve operated by a solenoid for choking more or less the inlet of a carburetor of an automobile for starting.

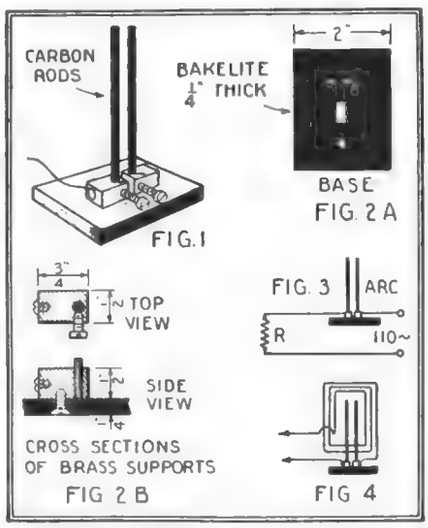
tension of the spring on the solenoid keeps the carburetor adjusting screw on the right side. When the car goes faster than 10 miles per hour the circuit is closed and the current passes through the solenoid. The plunger in the solenoid is then drawn in, thereby impoverishing the mixture given by the carburetor.

The Electric Candle

By A. BLUMENFELD

The automatic arc light is too complicated for the ordinary experimenter, and the adjustable ones too much bother to operate. Fig. 1 shows the diagram of one that is both automatic and simple. It was invented years ago; it is a version of the Jablockoff candle, and it never made a practical success, and has since been forgotten. But for experimenters it is ideal.

As can be seen it consists simply of two carbon rods suitably attached to a base. There are no moving parts, and it is simple to build. The stand Fig. 2 is made of slate or bakelite, being ¼-inch thick and 2 inches square. It has two holes cut in it, one of them rectangular, which may be filed out. This is to make the distance between the carbon rods adjustable. There are two brass pillars to hold the carbons. Each is tapped for three screws, one to tighten the carbon, one for the base, and the third for



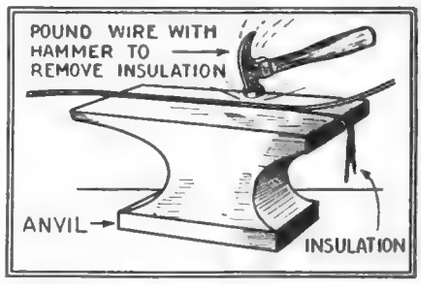
An electric arc light on the lines of the old time Jablockoff candle. No mechanism is required with this burner.

a binding post. Fig. 3 shows the hook-up. The resistance may be any one of high current carrying capacity, such as an electric iron or toaster. In order to start the arc, it is touched with a third piece of carbon at the top. When the arc has started, the piece of carbon is withdrawn. The arc will now burn to the bottom without any further attention of any sort. The thinner the carbon rods, the better it will work. Rods ⅛-inch thick make a nice arc. If light graphite rods such as come in draftsman's pencils are available, these should be used as they give a good arc. The leads usually have a diameter of 1/16-inch to ⅛-inch. They may be removed by boiling in hot water. Flat sided leads may be used from carpenter's pencils. These leads should be placed flat sides parallel. Round pencil leads may also be used. The soft ones give better results than the hard ones.

If the arc shows a tendency to waiver, then the carbons are either too thick or else it is because they diverge upwards. They should be made to converge slightly. As to length, they may be anywhere from three to six inches. The reason for the arc staying at the top of the candle, is magnetic repulsion. If a very steady arc is desired, this magnetic field may be aided by some turns of wire around the candle as shown in Fig. 4.

Stripping Rubber Insulation from Wires

By ROBERT L. LEWIS



How to get India rubber or gutta-percha insulation off of a wire.

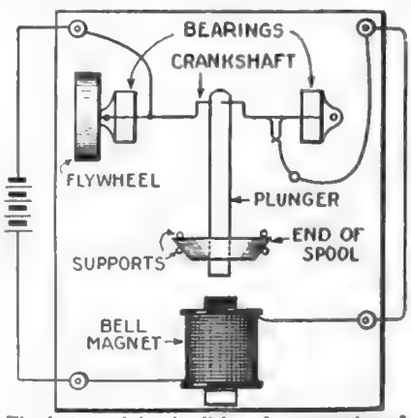
The following is an easy method to remove insulation from single strand wires larger than No. 14 gauge.

The wire, from which the insulation is to be removed, is laid upon some solid object, say an anvil, or the face of a flat-iron, and hit with a hammer. One blow will usually crack the insulation, baring the wire, so that the insulation falls off leaving a clean bare wire. Great lengths of wire may be easily stripped if needed. This applies especially to larger size wire which is very difficult to strip in any other way.

Toy Electric Engine

By W. LANCASTER

A paper clip straightened and then cut 2½" long and bent to have a 1/8" crank ½" from one end will make a very good crank shaft. The plunger is a rod with a hole bored in the end held up in the right line by the end of a spool as shown.



The last word in simplicity of construction of an electric motor.

The make and break is fixed on the shaft so as to open the contact when opposite to the position shown and to make contact as when shown.

When the plunger is nearest to the magnet there should be a 1/6" space between them.

Kinks for Experimenters

By RAYMOND B. WAILES

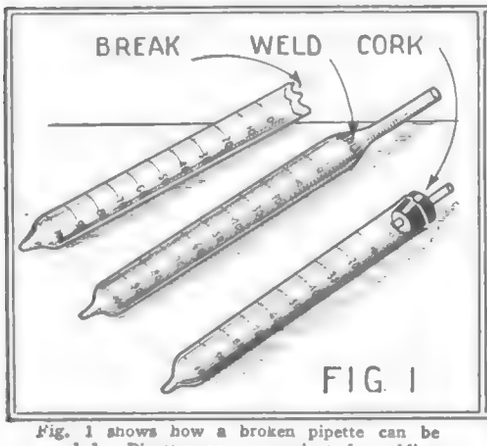


Fig. 1 shows how a broken pipette can be mended. Pipettes are convenient for adding solutions to storage batteries.

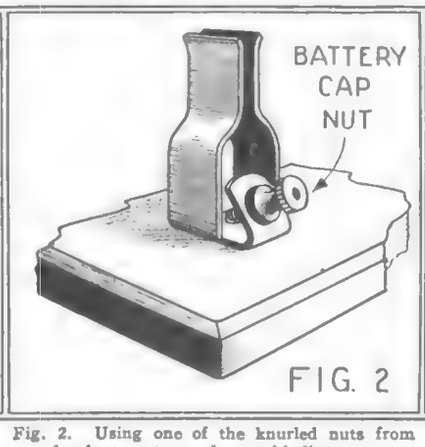


Fig. 2. Using one of the knurled nuts from a dry battery to produce a binding screw.

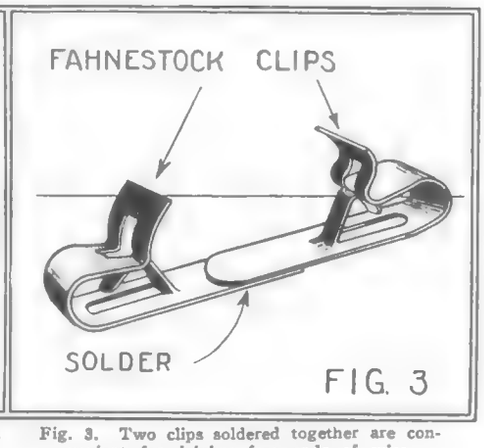


Fig. 3. Two clips soldered together are convenient for joining free ends of wire.

A BROKEN pipette of the sub-divided cc type, when broken, does not have to be thrown away, but can be made into a serviceable one as shown in Fig. 1. A short length of glass tubing can be added as shown, by welding or the break can be made straight and the additional mouth tube added by means of a cork bored to receive it.

A good idea which can be used where switches are to be constantly connected in and out of circuits is shown in Fig. 2. The small screws which are used as binding posts are normally screwed down tight on the wire going to this jaw. By soldering a knurled nut taken from a dry cell onto the screws, a screw driver does not need to be used in later connections of the wire to this terminal.

Two single Fahnestock spring binding posts soldered together are excellent for connecting two pieces of wire.

A good drain can be had by cutting the top off a large bottle and sinking it into the top of the laboratory table. Spent solutions, waste water, etc., can be poured into this acid-proof receptacle which will flow to crock placed below. Of course the other half of the cut off bottle makes a good battery jar for electrolysis, etc.

A graduate which has had its lip broken off can be made into a serviceable one by cutting off the jagged end square and then passing the end in the Bunsen flame until the edges have rounded off. Now by spotting a portion of the glass with the Bunsen where the lip should be, the glass will be softened there. A warm pair of forceps or a nail pressed upon the glass at this softened spot will readily enable one to form a lip on the graduate. This process is very easy to perform and can be done by one who has never made a weld or worked with glass. One precaution should be taken however; that is to heat the graduate slowly and after making the lip, soot the entire end of the graduate and allow it to cool before wiping off the soot.

A folded strip of emery cloth or sand paper removes cotton insulation from wire.

(*Continued on Page* 1148)

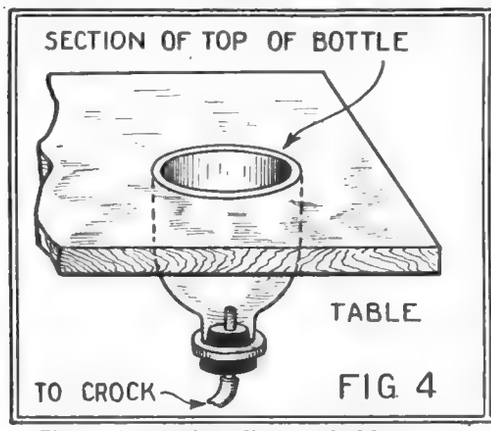


Fig. 4. A convenient adjunct to the laboratory table where storage battery fluid is to be gotten rid of.

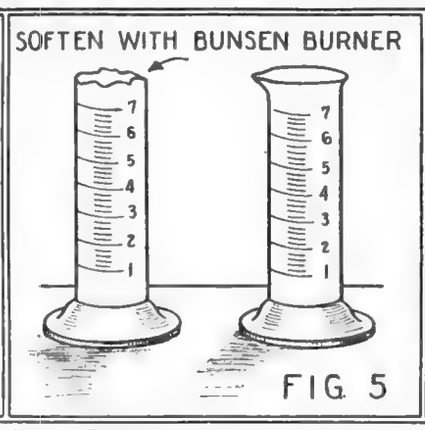


Fig. 5. Repairing a graduate so that it can be used advantageously; like the pipette, it is especially useful for storage battery work.

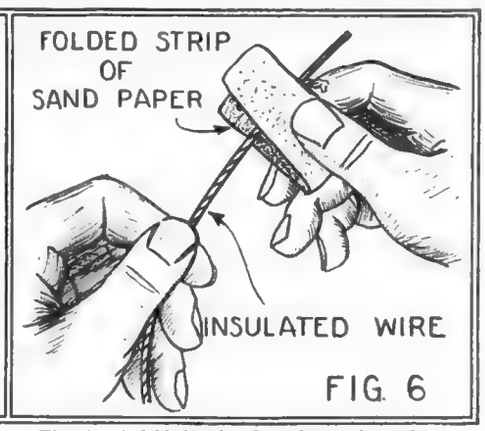


Fig. 6. A folded strip of sandpaper is used to remove cotton insulation from wire.

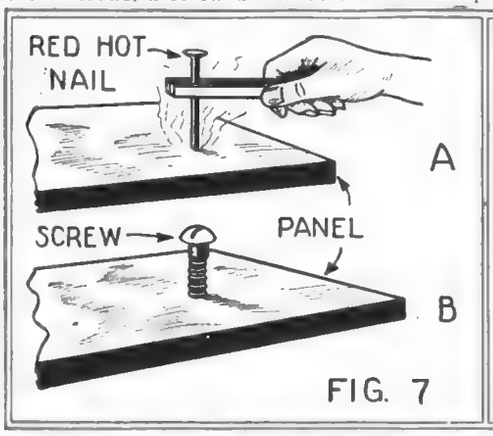


Fig. 7. Making a hole through a hard rubber radio panel. The screw must be put in very quickly while the India rubber is still soft.

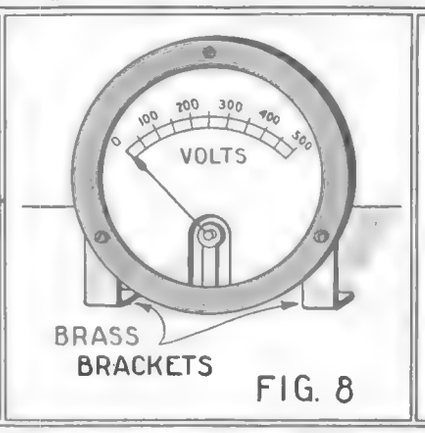


Fig. 8. A convenient mounting of a panel type voltmeter or ammeter so that it can be used on a table.

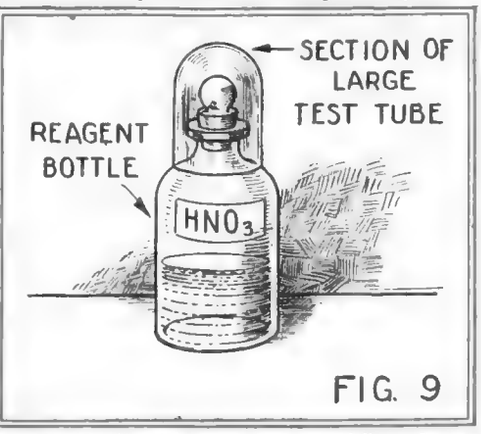
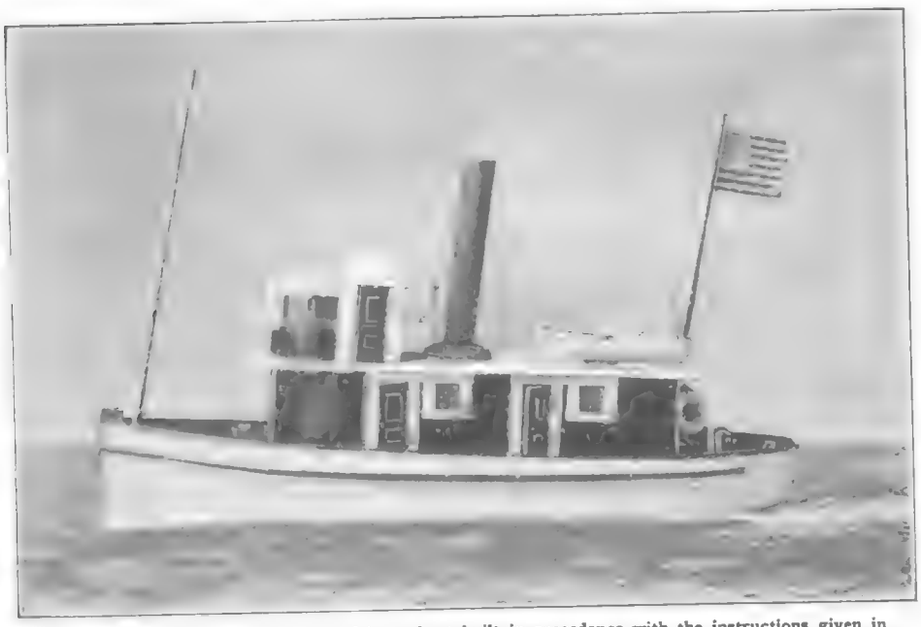


Fig. 9. Keeping acids clean, especially to be noted in the case of storage batteries for the battery acid.

THE CONSTRUCTOR

Building a Model Tug Boat

By PROF. F. E. AUSTIN



The photograph above shows a model tug boat built in accordance with the instructions given in the accompanying article as it appears under full power traveling through the water at a good rate of speed. This tug boat is electrically driven. It can be easily built by the average model builder, and the parts of its construction are not costly.

WHAT dandy fun it is to watch a trim model tug boat, gistening in the sunlight as she ploughs her way through the water dancing up and down over the waves on the nearest pond, throwing out a line of ripples from her bow while her spinning propeller churns the water into foam at her stern!

Don't we have a jolly fine time sending a barge-load of grain to our chum across the pond? Then after he gets his grain he sends a cargo of valuable goods back to us.

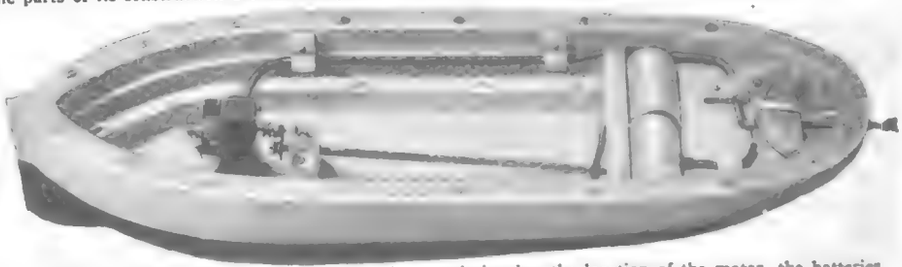
Perhaps our chum has made a steamer just as attractive as ours, then we have the most exciting races to find out which boat is the speedier, or can pull the greater load at a fair speed. Sometimes he will start his steamer on a voyage across the pond at the same time we start our steamer from our side; then how gaily they pass each other in "mid-ocean" on their passage across. You can have loads of fun with a tug boat because you can use one of these boats to tow your chums' model ships all over the pond when there is no wind and they cannot sail. Then, too, you and your chums can build small model barges to carry cargoes of grain, coal or lumber that can be towed by your tug boat across the pond and up the brooks into dandy harbors where you have built cities and store houses and docks with unloading derricks and conveyors, all run by electric motors, for loading and unloading the coal, and grain, and lumber.

But perhaps you have never built a model tug boat. Do you know I have just the very best news to tell you about building model tug boats? I don't know whether or not you have been waiting for this jolly good news before starting to build a right powerful one, but you won't have to wait another minute before you start working on it, after you have read the news. First, I must tell you that a tug boat can be made out of four pine boards by using a key-hole saw, and that the boat can be run by two small flashlight cells and a tiny electric motor. Now isn't that just the best news? Cheap to run, and a ten-year-old boy can make one!

Just look at the picture of the one on this page that has been on many thrilling voyages on lakes and ponds.

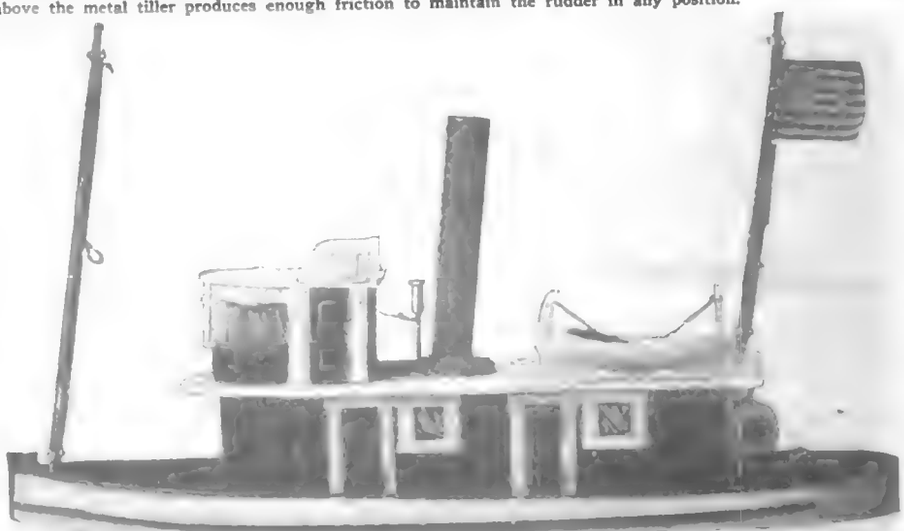
Of course the first thing to do when starting to build a tug boat is to draw the plans of it. Drawing shows you just how to do this, on a sheet of rather stiff brown paper, or cardboard. The dimensions are all marked out in squares as shown so that you can transfer the drawing to the drawing paper and make the plan just the size the boat is to be. It is quite good fun to make the plans; which can be done during rainy days. You will find it is a good scheme to cut out of cardboard a one-half pattern of the hull plan and fold this over to mark out the other side of the plan. You will thus be sure that the hull is alike on both sides.

(*Continued on page* 1163)



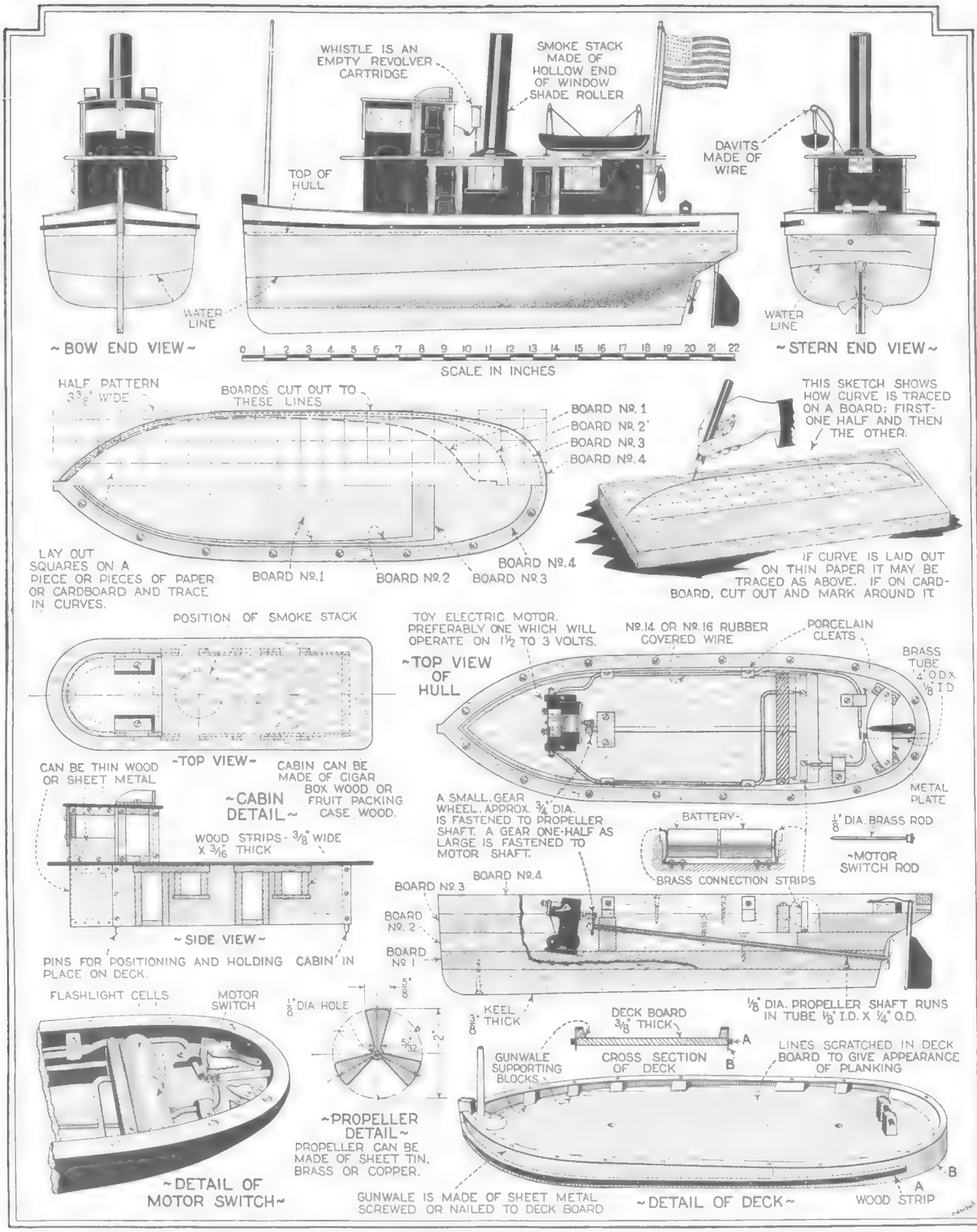
This is a view looking into the hull of the vessel showing the location of the motor, the batteries and the unique switching arrangement permitting the vessel to be started by pushing on the rod projecting from the stern. A brass rod completes the circuit between the two separate loops of wire. The plate above the metal tiller produces enough friction to maintain the rudder in any position.

Notice that the hull at the left is made up of four pieces of wood, each shaped, sawed out in the center and then screwed to its adjoining piece. The outside is finally shaped, smoothed and sandpapered.



The super-structure of the model tug boat is removable from the hull in one piece as the photograph above indicates. By this method it is possible to get at the motor, the gearing or at the batteries instantly to make repairs or to replenish the energy supplied.

Tugboat Constructional Details


WHISTLE IS AN EMPTY REVOLVER CARTRIDGE
SMOKE STACK MADE OF HOLLOW END OF WINDOW SHADE ROLLER
DAVITS MADE OF WIRE
TOP OF HULL
WATER LINE
~BOW END VIEW~
~STERN END VIEW~
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
SCALE IN INCHES
HALF PATTERN 3 3/8" WIDE
BOARDS CUT OUT TO THESE LINES
BOARD No. 1
BOARD No. 2
BOARD No. 3
BOARD No. 4
THIS SKETCH SHOWS HOW CURVE IS TRACED ON A BOARD; FIRST ONE HALF AND THEN THE OTHER.
LAY OUT SQUARES ON A PIECE OR PIECES OF PAPER OR CARDBOARD AND TRACE IN CURVES.
IF CURVE IS LAID OUT ON THIN PAPER IT MAY BE TRACED AS ABOVE. IF ON CARDBOARD, CUT OUT AND MARK AROUND IT
POSITION OF SMOKE STACK
~TOP VIEW~
TOY ELECTRIC MOTOR, PREFERABLY ONE WHICH WILL OPERATE ON 1½ TO 3 VOLTS.
No. 14 OR No. 16 RUBBER COVERED WIRE
PORCELAIN CLEATS
~TOP VIEW OF HULL
BRASS TUBE 1/4" O.D. X 1/8" I.D.
METAL PLATE
CAN BE THIN WOOD OR SHEET METAL
CABIN CAN BE MADE OF CIGAR BOX WOOD OR FRUIT PACKING CASE WOOD.
~CABIN DETAIL~
WOOD STRIPS - 3/8" WIDE X 3/16" THICK
A SMALL GEAR WHEEL, APPROX. 3/4" DIA. IS FASTENED TO PROPELLER SHAFT. A GEAR ONE-HALF AS LARGE IS FASTENED TO MOTOR SHAFT.
BATTERY
1/8" DIA. BRASS ROD
~MOTOR SWITCH ROD
BRASS CONNECTION STRIPS
~SIDE VIEW~
BOARD No. 4
BOARD No. 3
BOARD No. 2
BOARD No. 1
PINS FOR POSITIONING AND HOLDING CABIN IN PLACE ON DECK.
FLASHLIGHT CELLS
MOTOR SWITCH
1/8" DIA HOLE
5/8"
5/32"
2"
KEEL 3/8" THICK
DECK BOARD 3/8" THICK
1/8" DIA. PROPELLER SHAFT RUNS IN TUBE 1/8" I.D. X 1/4" O.D.
GUNWALE SUPPORTING BLOCKS
CROSS SECTION OF DECK
A
B
LINES SCRATCHED IN DECK BOARD TO GIVE APPEARANCE OF PLANKING
~PROPELLER DETAIL~
PROPELLER CAN BE MADE OF SHEET TIN, BRASS OR COPPER.
~DETAIL OF MOTOR SWITCH~
GUNWALE IS MADE OF SHEET METAL SCREWED OR NAILED TO DECK BOARD
~DETAIL OF DECK~
WOOD STRIP

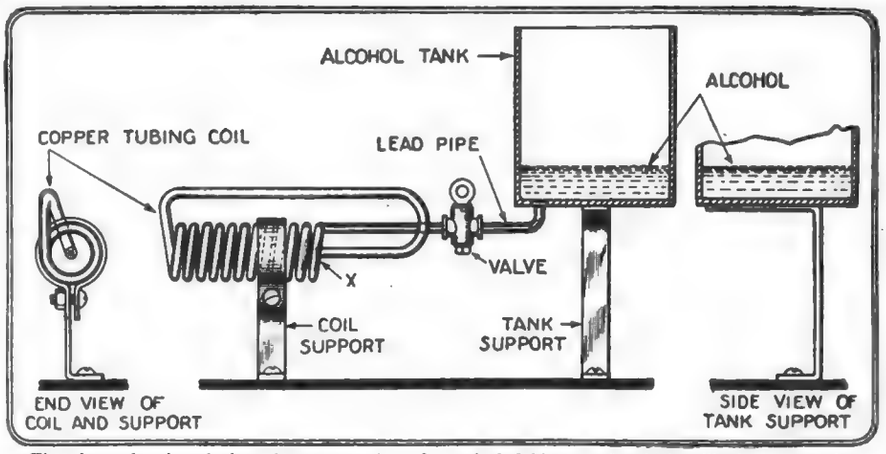
Above we see the constructional details of a model tugboat as built by Prof. F. E. Austin. It will be observed that a very unique form of switch for turning on the current is found in this particular design. The wire is twisted into two loops, the loops being separated from each other. When the brass rod is pushed in from the back of the tugboat, it closes the circuit. There is sufficient room in this tugboat to put a small storage battery in the hull or several groups of flashlight cells can be mounted in the hull and then wired in parallel. This boat makes very good speed when placed in the water and will run for a long time with but one battery. The rudder is moved by hand, when desired.

Blueprints are available from the "Model Department."

HOW TO MAKE IT

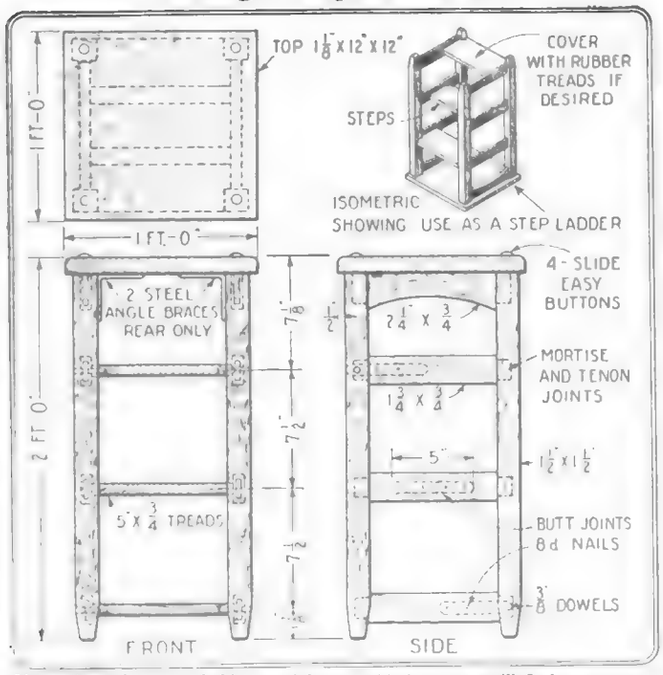
Building An Alcohol Blow Torch

IN the making of the alcohol blow torch illustrated here, ¼ inch outside diameter copper or brass tubing is wound on a round form ¾ inches in diameter. Before winding the coil the tube itself should be filled with sand to prevent it from breaking or closing up the passage. The end of the tube is then hammered shut and an opening is made therein about the size of a pin hole. A No. 60 drill or a needle can be used to drill this hole. The supports are of band iron, 1/16th of an inch thick, and ¾ of an inch wide, and are fastened to the coil and tank as shown in the drawing. The tank itself can be soldered to its support. A valve should be inserted as is indicated in the diagram. To operate the torch, permit a small quantity of alcohol to pass through the coils until it starts to drip out; then hold an alcohol lamp under the coil, the valve being again shut. When the torch starts to blow, open the valve and remove the lamp. The valve should be regulated carefully for best results. This torch will give sufficient heat for most purposes.—*Kenneth C. Stayton,* Rep. No. 26,401.



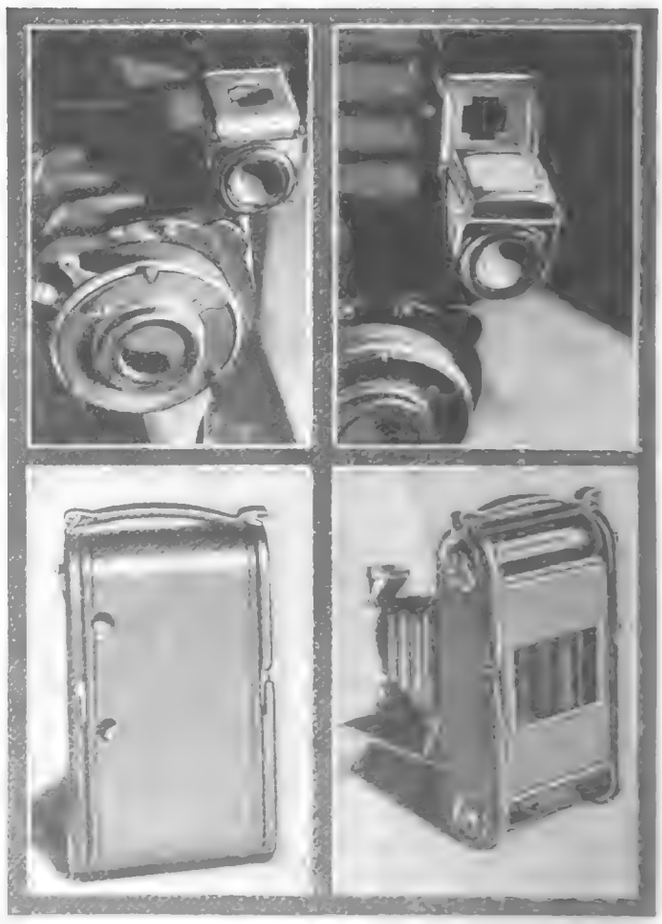
The above drawing depicts the construction of an alcohol blow torch which will give a very hot flame and which can be used for heating soldering irons, melting and brazing metals and for operating steam engines and steam power boats. The coil of copper tubing should be wound carefully and as shown, and all kinks should be avoided. The nozzle is shown in the drawing at X and is of the size of a pin hole.

Making a Step Ladder Stool



If you haven't a step ladder stool in your kitchen, you will find one a great convenience. When the right end is up you can use it as a stool several hours in the day when preparing food or ironing. Inverted, it is a sturdy step ladder. The plainest, cheapest wood, free of knots can be used. The legs are first built and then the end rails are constructed. They are all alike. The joints are mortised and tenoned. The arrangement of the steps is indicated by the dotted lines in the side view.—Edna Knowles King

Twelve Photos from Six Exposure Film

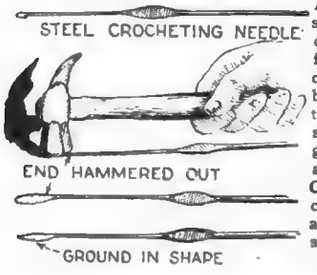


Any small film camera taking six pictures on the film can easily be made to take twice as many pictures half as big. The photo at the extreme right shows how a piece of sheet tin .015 inches in thickness is cut and placed in the back of the camera where it is held by two flat steel springs, one in the upper right-hand corner and the other in the lower left. Note that an extra ruby is inserted in the back. The film number is located in each ruby. In other words, the camera is used twice for small pictures. Observe double exposure.—Stanley Bochnik, Rep. No. 9380.

WRINKLES
RECIPES & FORMULAS

Edited by S. Gernsback

INSECT DISSECTING KNIFE

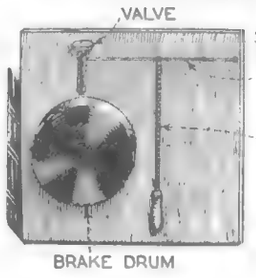


A small dissecting knife can be made from old crocheting needles by hammering the end flat, as shown, then grinding it to a razor edge. Good for microscopic examination of insects. — G. F. Mendenhall.

PAPER TOWEL FILTER

High grade paper toweling has been found far superior to imported filter papers as a filter for serums by a prominent manufacturer of biological products. — E. L. Dunbar.

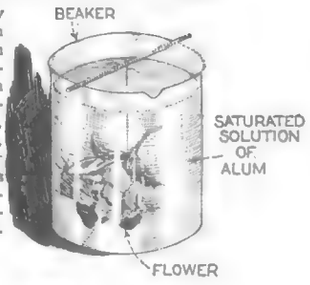
BRAKE DRUM GONG



A clear toned gong may be made by mounting a discarded brake drum as shown here. An engine valve stem is used as the striker, suspended on a 3/16-inch steel rod. — William S. Seimann.

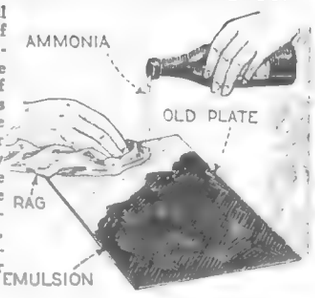
CRYSTAL FLOWERS

A flower may be covered with iridescent alum crystals by suspending it in a saturated solution of alum, undisturbed, for twenty-four hours. This preserves it indefinitely. — Lawrence Holdridge.



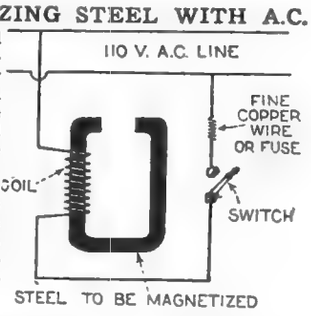
REMOVING PLATE EMULSION

Pour a small amount of household ammonia on the emulsion of photo plates then scrape with a knife or remove it by rubbing. The plates may be used for mounting specimens, etc.—F. Bishop, Reporter 25545.



MAGNETIZING STEEL WITH A.C.

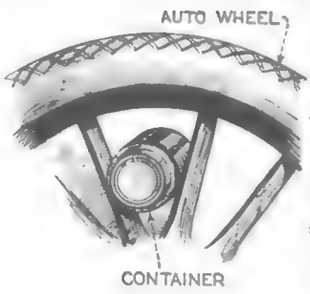
A piece of steel may be magnetized by winding a coil of heavy wire about it and connecting the wire as shown. The fuse will blow, but the sudden surge of current does the work.—William S. Seimann.



REMOVING BLOOD STAINS

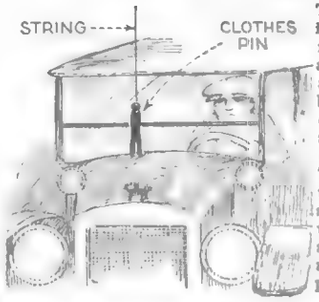
Blood stains may be removed by moistening the discolored fabric in a weak solution of tartaric acid in warm water. A porcelain wash basin should be used for immersion. — N. Zaretian, Reporter No. 25518.

OPENING SCREW TOP CONTAINERS



There is usually considerable trouble found in opening jars containing food when on camping trips, but difficult jars may be opened by taking advantage of the strong grip afforded thus.—Robert Maskell, Reporter No. 24875.

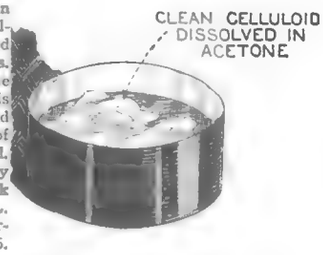
GUIDE FOR AUTOMOBILE



To aid in parking the automobile within a small garage, a guide may be constructed, consisting of a suspended clothes-pin. This will aid the driver in steering into the proper position. — Chesnur Psota, Reporter No. 26727.

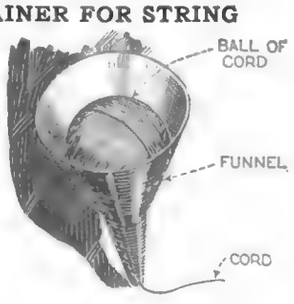
WATERPROOF VARNISH

Clean celluloid is dissolved in acetone and allowed to stand for a few hours. Then to one part of this mixture, add two parts of banana oil. Mix thoroughly and cork tightly.—A. L. Woods, Reporter No. 13916.



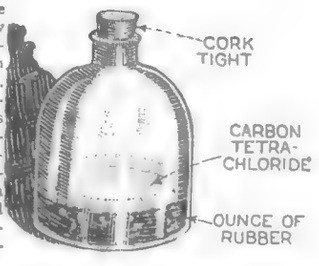
CONTAINER FOR STRING

A ball of string may be placed in a metal funnel, with the loose end hanging through the bottom of the funnel. No misplacement and no tangling of the cord is possible.

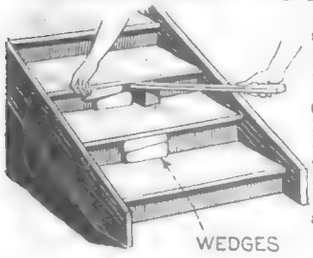


CHEAP RUBBER CEMENT

A good rubber cement can be made from raw rubber dissolved in carbon tetrachloride, known commercially as carbona or Pyrene fire extinguishing liquid. Clean rubber should be used.—Dorothy J. Newbury.

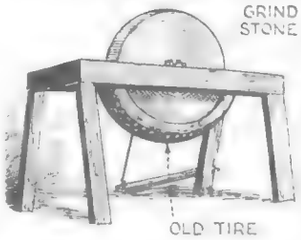


CURING CREAKING STAIRS



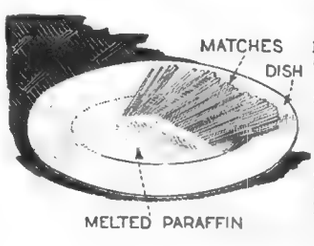
The treads should be pried up with a lever, and wedges inserted under them, as shown here. This will effectually prevent creaking or rattling of the treads against the risers.

GRINDSTONE RESERVOIR



A section of an old casing may be used as a water reservoir to keep the surface of a grindstone wet. The lower portion of the tire should be filled with water.—L. F. Kirkley.

WATERPROOFING MATCHES



Matches may be easily waterproofed without destroying their utility if they are dipped into melted paraffin. This does not affect the chemicals of the match. — Eric Palmer, Jr., Reporter No. 25436.

SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them in both palatable and unpalatable forms. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words and address your letters to Editor.—The Readers Forum, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.

BAKELITE ACCIDENTALLY PRODUCED

Editor, SCIENCE AND INVENTION:

In *Radio News* of November and December, Mr. O. Ivan Lee, in an article, "What Chemistry Has Given to Radio," mentioned Bakelite. The process is really an interesting one and is admirably described by Dr. E. Slosson in his book, "Creative Chemistry." Two disinfectants, carbolic acid and formaldehyde, are made to unite by catalytic action, with the formation of a solid and a liquid.

In the Chemical Encyclopedia the solid was referred to as an "impossible resin." Dr. Baekeland took the resin in hand and produced for us a material that he registered under the trade name of Bakelite, and now many other manufacturers are producing a similar material under other names.

A few years ago I had charge of the electrical equipment of a fleet of boats, and at one time was supplying current from a small dynamo to light up the hold of a large boat undergoing repairs. Going the rounds one day I noticed that a bearing of the dynamo was overheating and enquiring of the man in charge found that he had been using what he thought was cylinder oil to cool the bearing.

When I took the bearing out I discovered in the oil-well a handful of what appeared to be resin, with a smell of carbolic. I examined the can which was supposed to contain cylinder oil and found that it was disinfectant. The fireman had no sense of smell whatever.

On my way home I realized that the resin was really Bakelite. Apparently the disinfectant contained carbolic and formaldehyde, and with the heat and probably nickel dust from the partly seized bearing, for a catalyst, had produced the resin. The fireman had unconsciously turned the bearing into a laboratory and was making the "impossible resin." I imagine that others of your readers may have had similar experiences, which should make interesting reading.

WILLIAM WRIGHT,
Nelson, B. C., Canada.

(This letter does make interesting reading, and we are pleased to give it space in the Readers' Forum Department. As the author says, undoubtedly many other experimenters have had similar experiences. We shall be glad to hear from them.—EDITOR.)

LET MR. WELLER SUBMIT SOME

Editor, SCIENCE AND INVENTION:

I read in the *Readers' Forum* page of the January number of SCIENCE AND INVENTION of the extreme suffering being inflicted upon Mr. Maurice Weller of Dayton, Ohio, each month through the efforts and courtesy of your interesting magazine to furnish information and knowledge to the very ordinary people buying SCIENCE AND INVENTION every month.

I sincerely trust that consultation among your staff writers and yourself may find some means of elevating the extremely gross reference to How-to-Make-It, which interferes with the extraordinarily deep scientific thought radiating from Mr. Weller; without sacrificing the usefulness of your good paper to the ordinary reader who through misfortune or otherwise is not so learned as Mr. Weller.

J. McD. BRIGHT,
St. Louis, Mo.

(Our staff writers do not contribute the "How-to-Make-It" department of SCIENCE AND INVENTION *Magazine, so we shall be glad to have our readers submit such material as they think should be published on the "How-to-Make-It" pages. The readers are, in part, responsible for the material published on these pages. The editors have no fault to find with present suggestions.*—EDITOR.)

LEARN WHILE YOU SLEEP

Editor, SCIENCE AND INVENTION:

I have read the letter of the wireless operator, Mr. G. A. Vincent, on page 858—January, 1927, issue—of your magazine. I also remember the article you published about the experiments of the U. S. Navy.

The following incident was related to me and I should like to pass it on to you and have your views on the matter. It was told to me by the man to whom it happened; a man in whom I have the greatest trust, though you or some of your readers may have some doubt when you read it.

The man about whom I write is traveling salesman for a local wholesale house and his duties require him to do considerable automobile driving at night. He, as many other night drivers, has had the experience of falling asleep while driving and has adopted the plan of stopping a few minutes for a short nap when he feels himself getting sleepy. One night last summer he felt the need of a rest and pulled out to one side of the road, leaned over on the steering wheel and dozed off. The next thing he knew he found himself driving along the road, having started the car in his sleep and driven it about seven miles. He was off the road he had intended to take, but was in familiar territory over which he had driven before.

Whether or not this is akin to sleepwalking I do not know. What I have written is all that either he or I know about the matter.

K. A. THOMPSON,
Lexington, W. Va.

(We are inclined to believe that the driving of an automobile while the individual is asleep is very much akin to sleepwalking. There is no reason why an experienced driver could not start the automobile and proceed down the road and even stay on the road driving that car while sound asleep. The handling of a car becomes quite automatic after a few years of experience with it. In fact, it is as automatic as walking. Men on the march have been known to walk for hours while sound asleep, keeping time, and by instinct following those ahead of them. People have been observed to seemingly row a boat while sleeping, to apparently fly a kite, to run around the room, and to even walk along ledges of buildings when the slightest misstep might have resulted in a fatal fall. The peculiar part is that most of these individuals will return to their beds without knowing what they were doing while asleep. The same is true of car drivers. None of these incidents is as remarkable as that of learning the code while asleep. Even copying the code from a distant broadcasting station, or copying stenographic notes, is not as wonderful as the learning of a language or the memorizing of the code while the body is sound asleep. In hypnotic trances people can be made to memorize more rapidly than when they are awake. This may be due to forced concentration and it likewise seems to follow that those asleep should be able to learn with greater rapidity than persons awake. There is much room for experimental research along this particular line. It should be simple to place a pair of earphones on the head of a sleeping individual and have him memorize a new song or a new language, while taking his nightly nap. In this way he is mastering something, which he has not done before. Most stenographers take their shorthand notes in an automatic manner and rarely question the sense of the dictation, nor are they ordinarily given to following the dictator's trend of thought. Without a great stretch of the imagination, they could do those same things, while asleep, just as a person can walk, drive a car, run, copy the code, operate a railroad locomotive, apparently row a boat or fly a kite, swim, or perform other semi-automatic actions—but when we make him learn something new, develop something entirely foreign to general routine, we open up an entirely new field of research.—EDITOR.)

AMAZING STORIES

IN OUR APRIL ISSUE:

THE PLAGUE OF THE LIVING DEAD, by A. Hyatt Verrill. The author of "Beyond the Pole" and "The Man Who Could Vanish" has written a most remarkable tale which comes pretty close to straining your credulity, but at the same time you will say to yourself over and over that there is nothing impossible about it. Immortality IS possible, as recent researches at the Rockefeller Institute have indicated; that is, animal tissue can be kept alive indefinitely. You will be thrilled by Mr. Verril's story.

JOHN JONES'S DOLLAR, by Harry Stephen Keeler, which shows the tremendous proportions the very meagre sum of $1.00 can attain if left in the bank and computed at compound interest for a number of generations. It is most astonishing.

WHITE GOLD PIRATE, by Merlin Moore Taylor. An absorbing detective story about a daring criminal who baffles many authorities interested in the mysterious disappearance of enormous quantities of platinum. A scientific detective uses the X-ray, finger prints and the phonograph in a particularly interesting manner, making this is a most plausible story with a true scientific aspect.

HICKS' INVENTIONS WITH A KICK, by Henry Hugh Simmons, in which an entirely new thing in dining tables and service is promulgated. Naturally, being a new invention, mishaps occur, but that only adds to the fun for the reader. A very interesting idea, well told.

THE BALLOON HOAX, by Edgar Allan Poe. Although balloons have long since been a reality, we cannot fail to be impressed by the scope of the author's scientifiction knowledge and prophetic vision. Also, the story is written in Poe's inimitable style, which in itself assures you of fifteen minutes well spent.

THE LAND THAT TIME FORGOT, by Edgar Rice Burroughs (Part III). Those of you who are wondering what and why the Wieroo are and what happened to the rest of the party that landed on Caspak with Bowen Tyler and Lys LaRue will find the answer in the next five thrilling chapters, which conclude this story. The same pitch of exciting interest is maintained throughout the story.

S. & I.—A HIGH SCHOOL TEXT

Editor, SCIENCE AND INVENTION:

Aeronautical Engineer, William P. Sullivan, author of many worthy articles, particularly his "How Byrd Found North Pole" of October's issue; is exceptionally gifted with the ability to handle difficult problems in simple language. Not only was this last article clearly and interestingly expressed, but it carried with it a well-timed educational message that appealed to the instructors of this institution.

Mr. Sullivan's article was of great assistance to me in explaining methods of determining positions to the Civil Engineering Classes of this school. I trust we will be favored with many more such excellent articles by Mr. Sullivan.

JOHN E. BALE,
Civil Engineering Instructor.

I also must express my deep appreciation of Mr. Sullivan's work and have used his article to great advantage in the Science Department.

A. H. SMITH,
Head of Science Department, Mission High School, San Francisco, Calif.

(This is only another of the many letters which SCIENCE AND INVENTION *Magazine regularly receives from the Science and Engineering Departments of high schools and colleges throughout the United States.* SCIENCE AND INVENTION *Magazine is being used to a greater extent every year as a science reference handbook. It is the only medium of keeping abreast with science to be found in this country today, that is written in pure, understandable, non-technical language. In addition to* SCIENCE AND INVENTION *Magazine, this organization publishes a School Service bulletin which will be sent to any school teacher requesting the same, without any charge whatever. This bulletin will help the teacher to properly formulate her questions, and will give her general information in a concrete form about the new things in Science. In addition to that, it contains much other useful information for the instructor.*—EDITOR.)

WANTS MORE GENERAL SCIENCE

Editor, SCIENCE AND INVENTION:

I am very much in agreement with Mr. Maurice Weller (*Readers' Forum,* Jan., 1927). Let us have more general science and less "How-to-Make-It" and woodcraft, matchcraft, and wirecraft contents! I wonder how many per cent of your readers make the "Roman Ballista" or the telescope!—Please, stick to the name of the magazine! Let us have "SCIENCE AND INVENTION"—not substitutes and children's toys!

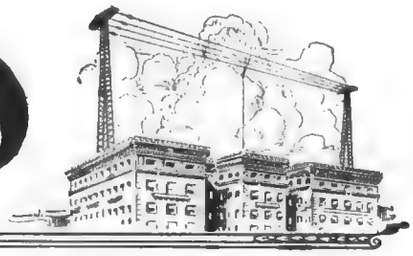
These are some of the articles I liked best in 1926: New Helicopter-Airplane—The Light-Beam Piano—Is Einstein Right?—The Moon's Atmosphere—Can the Dead Be Re-United?—The Origin of the Earth—The Origin of the Moon—Norge's Flight Over the North Pole—Could a Whale Swallow Jonah?—The Truth About Astrology—Sun Spots, the Weather and Crops—Free Cathode Rays—and all your editorials!

This is what I like, and I hope to have more of it.

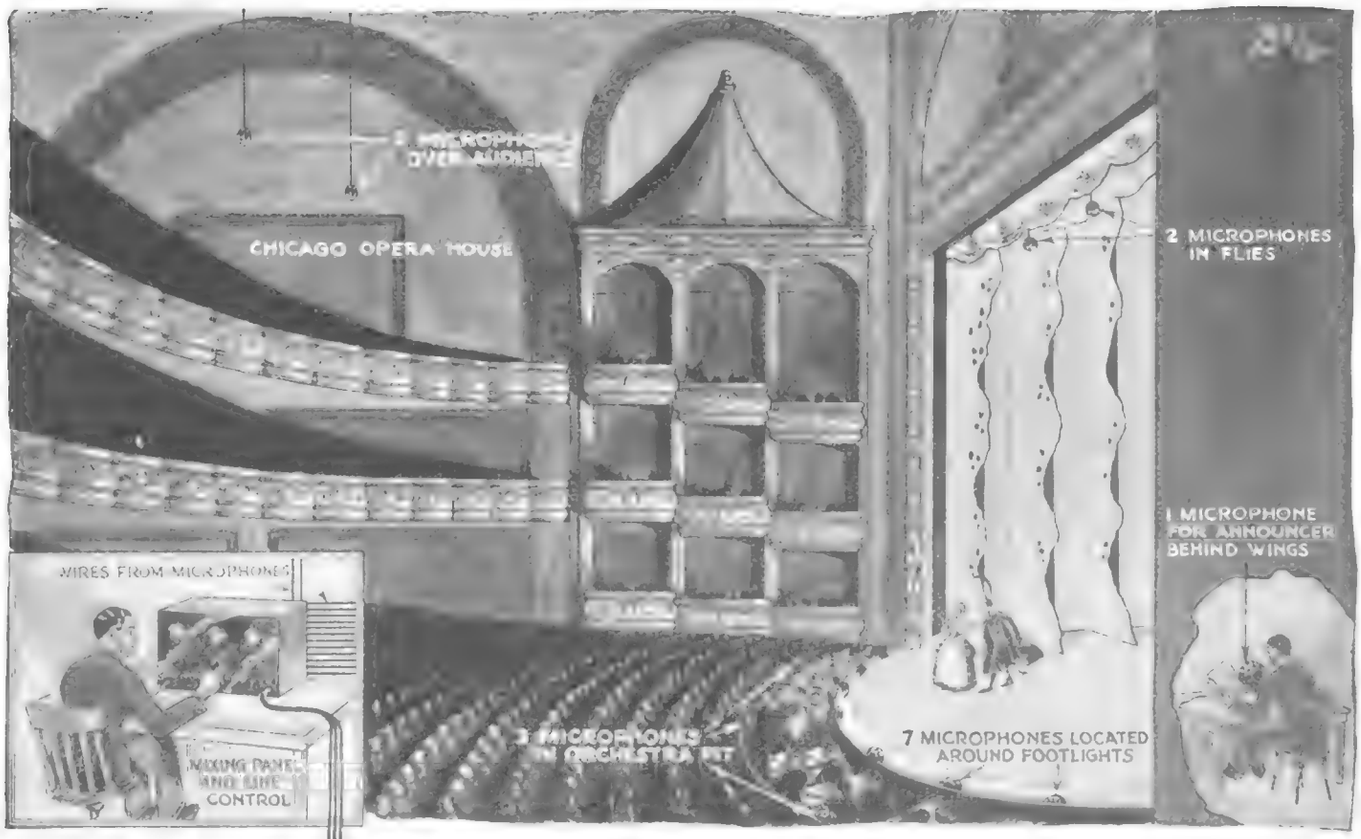
KRISTIAN HARESTAD,
Norway, Europe.

Vastly more people are interested in making of the telescope, than in any of the feature constructor articles which have been running during the past year. We are, of course, judging from the number of replies which we have received concerning this article, and we are gratified to know that people are interested in the constructing of a telescope, because, by so doing, they likewise become educated in astronomy, which is one of the most glorious of sciences. At the present time an amateur can construct a low-priced telescope, having twice the power of the one that the famous Gallileo used.—EDITOR.)

RADIO



How the Chicago Opera Is Broadcast


CHICAGO OPERA HOUSE
2 MICROPHONES IN FLIES
1 MICROPHONE FOR ANNOUNCER BEHIND WINGS
WIRES FROM MICROPHONES
MIXING PANEL AND LINE CONTROL
7 MICROPHONES LOCATED AROUND FOOTLIGHTS
3 WIRES FROM CHICAGO TO NEW YORK
CHICAGO CENTRAL OFFICE
LISPENARD BUILDING NEW YORK LONG-LINES DISTRIBUTING OFFICE
TO WEAF AND RED NETWORK
TO WJZ AND BLUE NETWORK

Fifteen microphones were installed by the engineers of the National Broadcasting Company in the Auditorium, Chicago, where the "Garden Scene" from Faust, as produced by the Chicago Civic Opera Company, was broadcast on January 21st. This program went on the air through the combined Red and Blue network of the N. B. C.

THE largest single audience which has ever heard an operatic performance were able to listen to the last act of Gounod's "Faust" on the evening of January 21st. At that time 25 stations of the National Broadcasting Company red and blue network were linked by special circuits to broadcast the second act of the Chicago Civic Opera Company's regular production of this opera direct from the stage of the Auditorium in Chicago. The stations in the chain are as follows: WEAF and WJZ, (New York); WEEI, (Boston); WBZ, Springfield and Boston; WJAR, Providence; WCSH, Portland, Maine; WGY, Schenectady; WGR, Buffalo; WTAG, Worcester, Mass.; WLIT, Philadelphia; WRC, Washington; WHAS, Louisville; WSB, Atlanta; WSM, Nashville; WSAI, Cincinnati; WTAM, Cleveland; KDKA and WCAE, Pittsburgh; KYW and WGN, Chicago; KSD, St. Louis; WWJ, Detroit; WOC, Davenport; WCCO, Minneapolis-St. Paul; and WDAF, Kansas City. Fifteen separate microphone channels are used for broadcasting, each one consisting of one or more microphones, all of which lead to a specially-designed mixing panel where the music absorbed by the various microphones is first amplified separately and then blended so that each portion carries proper emphasis. The microphones are distributed at points of vantage on the stage, in the flies and wings along the apron of the stage, in the orchestra pit, and high over the heads of the audience in the auditorium proper. Even the back wall of the stage has its pick-up arrangement. Every portion of the music and orchestral accompaniment can be carried to the mixing panel.

The program was first transmitted over a three-wire system direct to New York, then distributed nationally.

Skip-Wave Radio

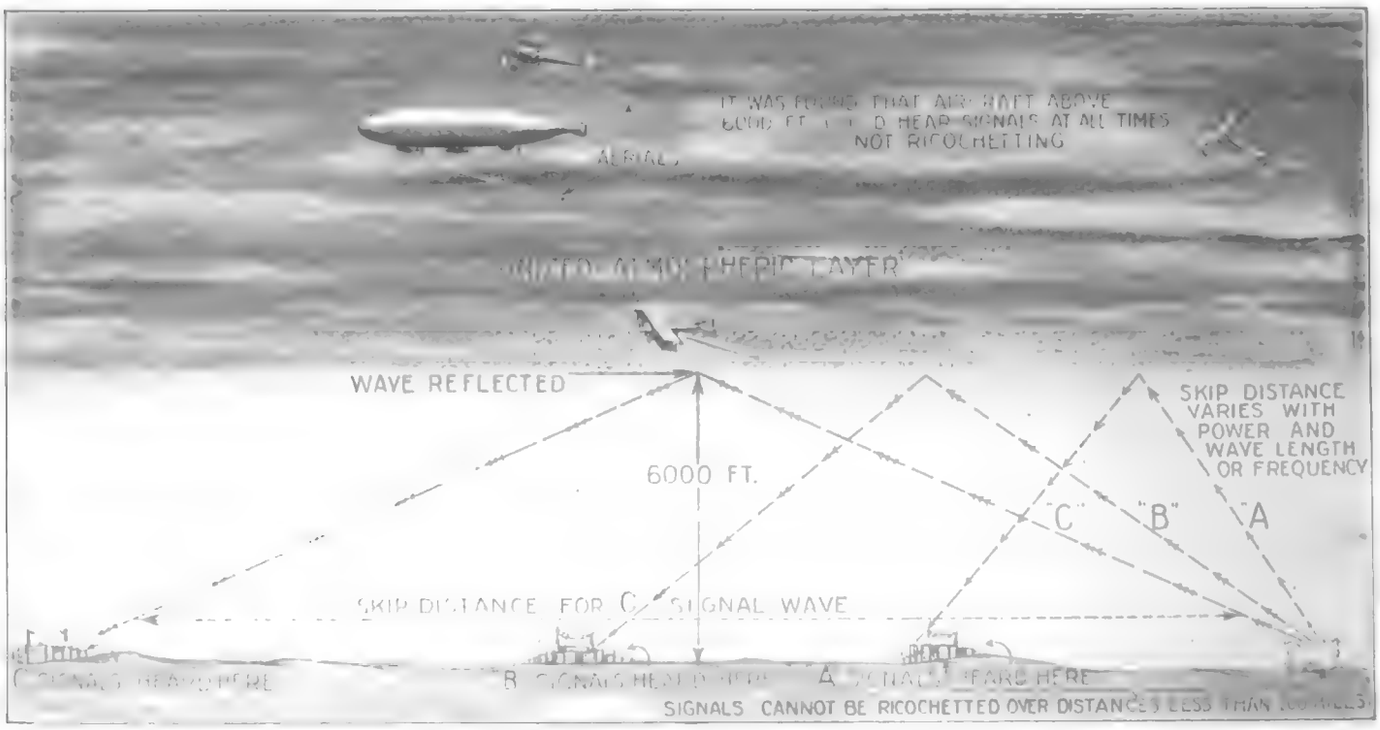
By G. K. SPENCER

Major Francis Pierce, radio officer of the U. S. Marine Corps, who has been conducting experiments in ricochetting (skip-wave) radio.

A RECENT radio development, announced by Major Francis E. Pierce, of the U. S. Marine Corps, by means of which radio signals can be ricochetted over intervening objects between the sender and receiver of the signal, is regarded by the U. S. Navy experts as a valuable contribution to science. Tests have been conducted at North Island, California, which indicate that it is possible to completely skip over an "enemy" ship, and cause a radio signal to be audible on a friendly ship at any required distance. The experimentation is being limited to short wave transmission, as it is found that the high frequencies produce the effect desired better than the long waves. The theory advanced by the experimenting engineers is that the signal is reflected from an ionized atmospheric layer which is in the form of an envelope, distant about 6,000 feet from the surface of the earth. The idea is, by means of directional transmission, to emit a radio "beam" at a predetermined angle, the beam being reflected at a corresponding angle from the surface of the ionized layer to the vicinity of the receiving station. It was found that the skip could not be controlled over distances less than 200 miles, but above this range the control is quite accurate. Hugo Gernsback has advanced another theory, illustrated at the right, which seems to cover most of the phenomena.

AIRSHIP COULD HEAR SIGNALS HERE
(AIRCRAFT COULD NOT HEAR SIGNALS) IN THIS ZONE
TRANSMITTING STATION
SKIP DISTANCE FOR THIS PARTICULAR WAVE
REFLECTING LAYER (ORE ETC.)

Mr. Gernsback suggests that the wave may be reflected from a layer of ore below the surface of the earth. This checks with the other theory except that an airplane would probably not be able to hear a signal unless it were directly in line with the ricochetted beam.



Major Pierce believes that the waves are reflected from the layer of an ionized atmosphere which is situated at an elevation of about 6000 feet. It was found that the skip distance depends upon the angle at which the directional wave is transmitted, or upon the frequency and power of the emitted signal. It will be seen that the angles of incidence and of reflection from the ionized layer are taken as equal.

A Single-Control Six-Tube Receiver

An Excellent Set Incorporating the Loftin-White Circuit

By L. A. BRAMS

The set was installed in a special cabinet, made of beautifully mottled green casein, which was constructed by the writer. There is one active tuning control, the upper knob. The knob just below this control is a vernier for the first stage of radio frequency. Under this is the filament key switch. The other two knobs are rheostats. An interesting feature of this set is the fact that it is calibrated directly in meters, which makes it very simple to tune.

Photos Courtesy Hartman Electric Co.

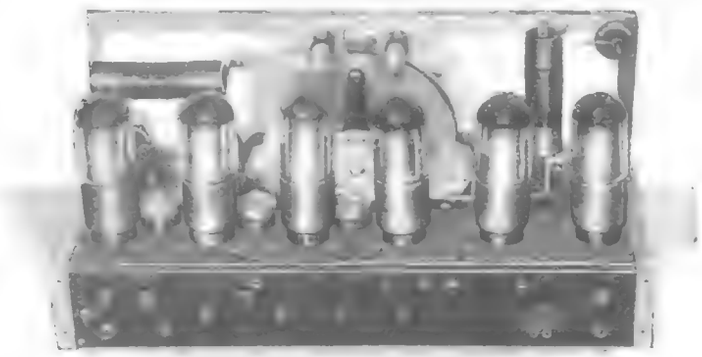
THE general tendency in the design of receiving sets seems to be in the direction of single control, where one adjustment and one only is needed to vary the wavelength of the radio-frequency amplifier. There are a number of such sets on the market at the present time, and of all these there are but few which may be termed really efficient. The deficiency hardest to overcome is that encountered in attempting to tune the various stages of radio-frequency amplification to resonance with the incoming wave, so as to attain the maximum degree of amplification with the greatest possible selectivity. This may be easily done where each stage is separately adjusted to resonance by its own tuning control, but it is a much greater problem where the stages must be tuned together from a single control.

Several types of gang-control have been adopted by as many manufacturers, with varying degrees of success. In the set illustrated on this page, an entirely new type of gang-coupled variable condenser is incorporated. While this particular arrangement adds much to the attractiveness of this set, it is not essential that the experimenter employ this gang-condenser in preference to any of the other good systems of coupling. As it stands, the circuit alone is interesting enough to give the amateur set-builder a good opportunity to try out his skill, and the results should more than justify the trouble taken in assembling the parts.

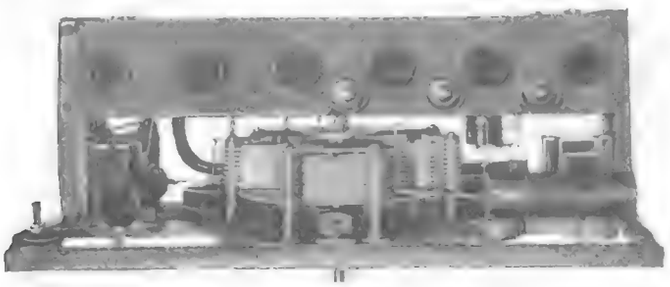
The particular set illustrated here is constructed by a mid-western manufacturer, and has been tested in the laboratories of SCIENCE AND INVENTION with excellent results. The tuning is miraculously sharp, and the sensitivity compares favorably with that of any of the sets which have been popular in the past few years.

The stators of three of the condensers are arranged in a cloverleaf pattern, while a common rotor of similar design is on a single shaft. There are two other variable condensers in the circuit. One, which tunes the first stage of radio frequency is mounted rather obscurely at the back of the gang condenser, with its rotor connected to the common shaft. The second and last of the condensers mentioned is a small vernier whose knob is mounted under the main tuning control. The presence of this control should not cause the reader to shriek "I told you so!" as he visualizes another "single control" set which needs an octopus on roller-skates as an operator to get any results. It really isn't as bad as all that, because the vernier need not be touched unless DX is expected, and then only after the main tuning control has been permanently set.

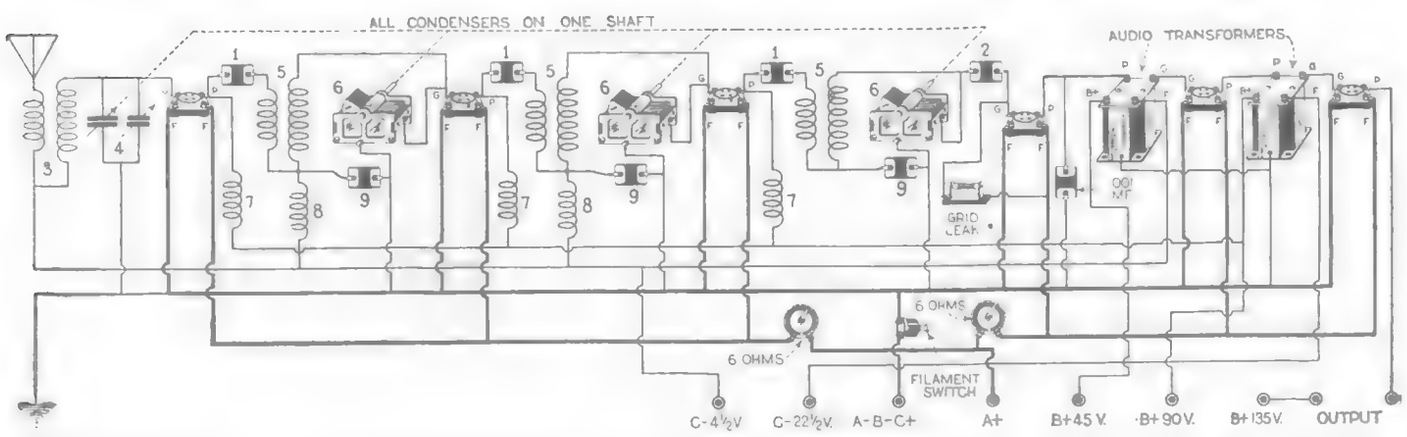
The characteristics of the apparatus used in this set will be found very much the same as those of the standard Loftin-White sets, several of which have been published in recent editions of RADIO NEWS and other radio magazines.



A rear view of the chassis upon which the parts are assembled. An approximate idea of the appearance of the gang condenser may be gained from this photograph. Note the size of the inductance coils, which are wound on 1-inch tubing. Heavy cabled wiring is used throughout wherever possible.



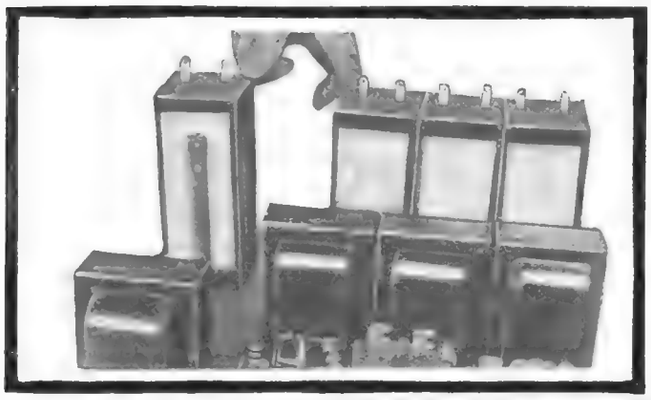
A top view showing the clover-leaf gang condenser. The parts are assembled on a cast aluminum chassis to secure strength and rigidity. This set when tested was found to be highly selective and unusually sensitive.



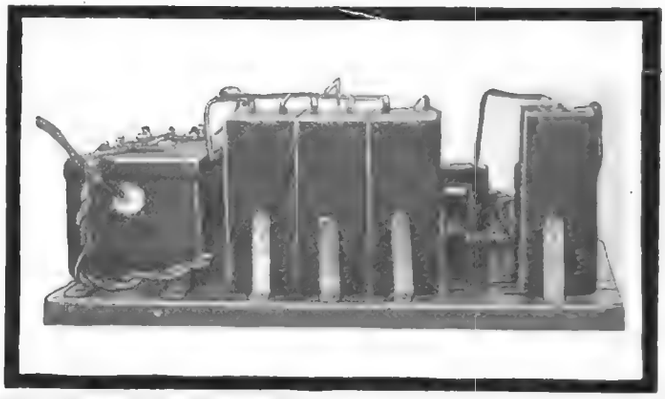
The circuit diagram. 3, 5, TRF transformers, primary 8 turns, secondary 70 turns; 6, .0005-mf. condensers; 4, .0005-mf. condenser with vernier; 7, 8, RF chokes, natural wavelength 300 meters; 9, .004-mf. condensers; 1, .0003- to .001-mf. condensers; 2, .0005-mf. condensers. These are the constants which are used in most of the Loftin-White circuits at present on the market, but slight variations may be found desirable in practice. Of course any type of audio-frequency amplification may be used, although that shown here gives very gratifying results. See the text for further suggestions. Any type of gang condenser of the proper value may be used.

"B" Eliminator and Power Amplifier

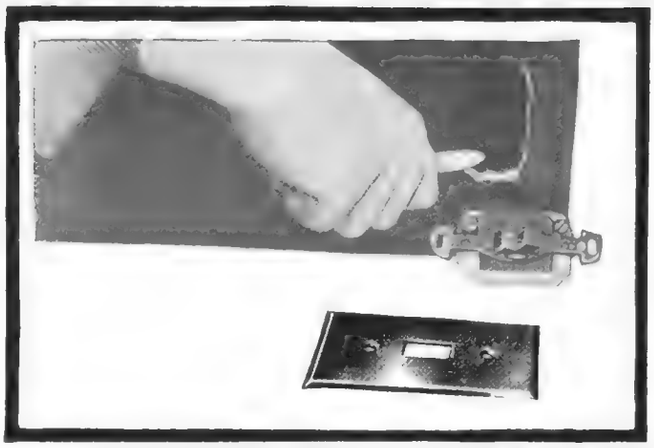
By HERBERT HAYDEN



The condensers, which are of the high voltage type, are shown above before wiring. Each condenser should be clamped down to the base board with brass angle-irons, to prevent vibration which might otherwise disturb operation.

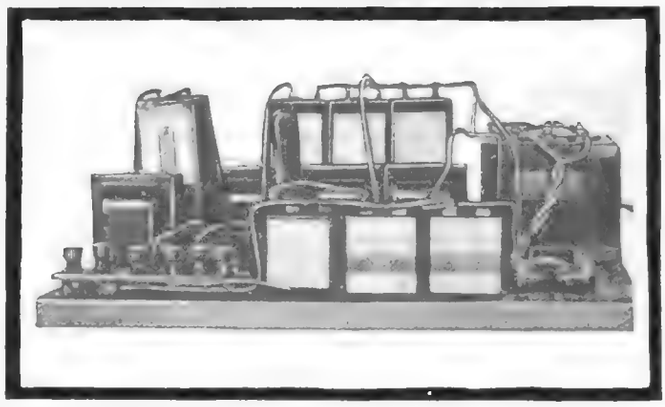


The power transformer is seen at the left in the above photograph, taken from the back of the combination eliminator and amplifier described in the article. Any one of the standard "B" eliminator transformers may be used with the circuit to provide plate and filament current as required.

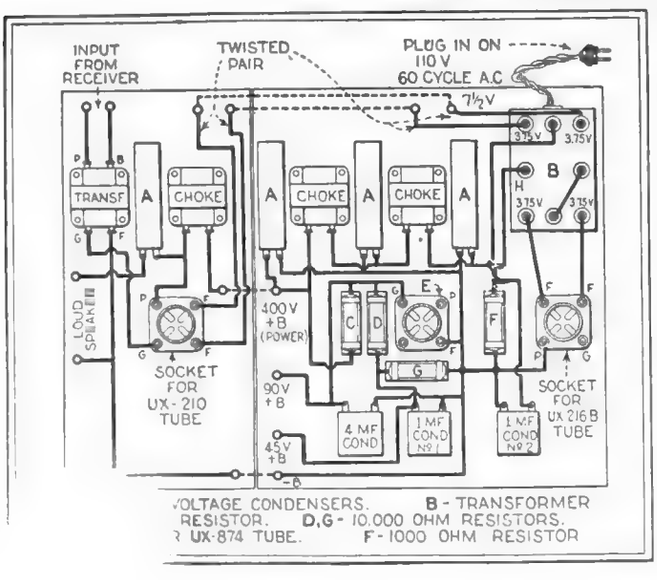


THE tendency in radio design seems to be definitely toward simplicity. Sometimes it is difficult to reconcile this idea with some of the necessarily complicated mechanisms which must be built to fill stringent requirements. It is particularly noticeable in the case of special high voltage "B" battery eliminators that it is difficult to build the device so that it will be perfectly safe to use and at the same time highly efficient.

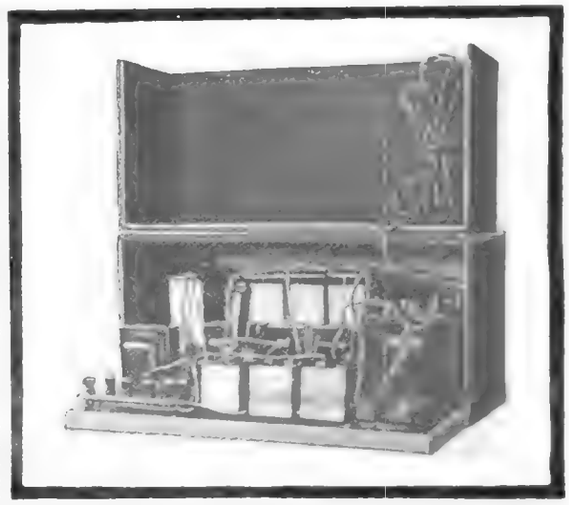
It was the intention of the designer to construct in one unit a "B" battery eliminator and a one-stage power amplifier. One of the requisites was that the eliminator should have a high voltage output and at the same time have no exposed wiring to endanger children who might play around it. It was obviously quite simple to eliminate the exposed wiring by enclosing the entire unit in a substantial box or cabinet. This device was employed in the construction of the unit illustrated on this page, and the apparatus is so arranged that one toggle-switch of the same type used in home lighting installations is the only control necessary to operate the unit. This switch is mounted in a convenient position, where it may be easily reached, and it will be seen that it detracts not at all from the appearance of the cabinet. As to the electrical characteristics of the amplifier and eliminator, much may be learned by an inspection of the layout and diagram given here. The eliminator is designed for use with the UX-216 B half-wave rectifier tube, which is part of the



The unit is wired with heavy wire such as No. 8 soft copper, rubber covered, or the type commonly known as BX wire. The half-wave rectifier tube socket is at the right in front of the power transformer. The ballast tube is hidden behind the three small block condensers, while the amplifier tube is behind the row of binding posts at the left. An unique feature of this circuit is the use of a special ballast tube, which is connected in series with the output of the transformer to ensure a constant voltage supply of the tubes.

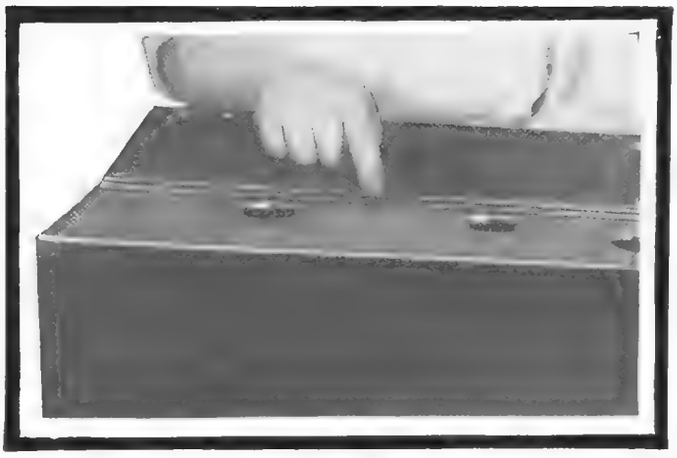


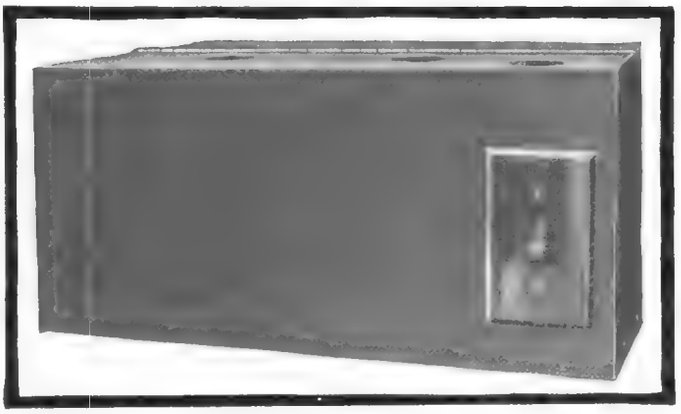
At the left, the layout of the complete unit. For the sake of convenience, the amplifier and the eliminator portions are shown as if in separate units, although in this set they were placed in the same base. It may be found more satisfactory in some cases to separate the units.



The entire unit, consisting of an eliminator and one stage of power amplification, is placed in a solidly constructed box to prevent the possibility of inadvertently touching the contacts and receiving a dangerous shock in consequence.

Wire netting is nailed over the ventilating holes in the top of the cabinet, so as to make it unlikely that any metal parts or tools might drop in and cause a short-circuit. Copper gauze makes a very good material for this use.





Above, the movable portion of the top of the cabinet is hinged to the cabinet proper. A long piano hinge is desirable because of its strength and because of the fact that it tends to hold the wood in shape and prevent warping. A tumbler switch, the only control necessary with this unit, is mounted on the side of the cabinet in a position where it might be easily reached. An important feature of this outfit is that no high tension leads are exposed.

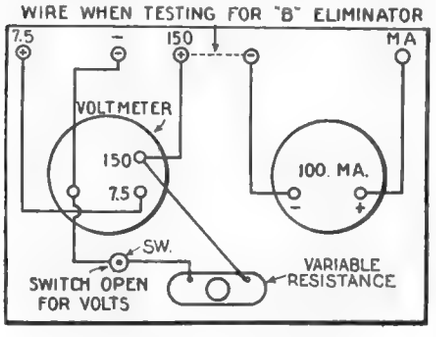
standard equipment in Radio Corporation eliminators. Any half-wave rectifier tube of similar characteristics may be employed. An unusual feature of the eliminator is the use of a ballast tube, type UX-874, which is used to ensure a constant current output regardless of voltage fluctuations in the AC line. The chokes used in this eliminator have an inductance of 30 henries. All of the constants of the circuit are given in the diagram. The transformer is a standard commercial make, as it is not recommended to build such a transformer.

Measuring Voltage of "B" Eliminators

By J. C. BANK

THE modern B-Eliminator as built today is in a high state of perfection and being flexible and simple to operate, the radio set owners find it an excellent outfit for multi-tube sets. Due to chokes and resistances necessary in its construction for satisfactory operation, the variation of voltage caused by changes in current is considerable.

Very often the voltage at some operating point is to be determined. An average good voltmeter draws from 10 to 15 milliamperes for its operation. Since the internal resistance of the eliminator is considerable, a current of this magnitude when added to an existing load of say 20 milliamperes, drawn by the set would give a reading on the voltmeter below what it actually is when the set only is connected. In other words, for every different value of current with a given setting of the eliminator a different value of voltage is obtained.



Meter test set for "B" Eliminator.

If we had a voltmeter operating on no current there would be no change in output voltage if connected when a set is in operation, but since this type of instrument is not practical some current must be consumed. One manufacturer has placed on the market a voltmeter having a full scale reading of 250 volts and drawing but 1¼ milliamperes at that voltage. Thus at 135 volts the current consumed by the meter is but 0.675 milliampere and for lower voltages proportionately less. When this is connected it gives practically a true reading of the eliminator voltage applied to the set if no voltmeter current were taken.

Being a very sensitive instrument, its cost is greater than that of a standard one of equal capacity, so that other means of testing must be resorted to if a voltage reading is desired. One way is to leave the regular type of good voltmeter in the circuit while the set is in operation. Of course the eliminator will be required to give a current equal to that taken by the set plus that taken by the voltmeter. This extra load may be too much for some eliminators where the output power is limited.

A very good way is to test with a voltmeter and milliammeter and variable resistance as for instance the Clarostat or Bradleystat. With this apparatus connected as explained below the eliminator can be calibrated and a curve drawn or table made showing the various output voltages at different rates of current. With this curve or table and the milliammeter in the plate circuit, when the set is in operation the operating voltage can be determined by reading the milliammeter and referring to the curve for the corresponding voltage. Before testing connect the eliminator to the set in order to get a setting of the eliminator controls at which one gets the best reception. With the setting of controls undisturbed the calibration test is made and the resulting values will be at this particular setting only. By setting the controls at the maximum points the maximum capacity of the eliminator in current and corresponding voltages can be determined.

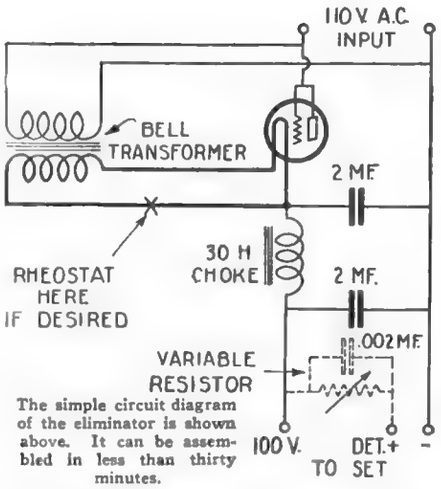
The voltmeter should be either a two-scale type of 7½ and 150 volts or a 250-volt instrument if the low range is not desired and the higher value is needed. Instruments of this type are on the market, the former in 2- and 2½-inch sizes and the latter in 2½- and 3-inch. The milliammeter is obtainable in any of the above sizes and the 100 milliampere is the proper one to cover all types of eliminators.

The panel size will depend on the types of meters purchased. If a 250-volt instrument is used the 7.5 binding post and connection is omitted. With these connections either the voltmeter or milliammeter may be used separately or both on separate circuits. For eliminator testing connect a piece of wire from the negative of the milliammeter to the positive of the voltmeter (150 in sketch) and close the switch SW. The switch must be open for other voltmeter tests. Connect the eliminator positive to that of the milliammeter and the negative to that of the voltmeter. (*Name of manufacturer on request.*)

Special Voltmeter for "B" Eliminator

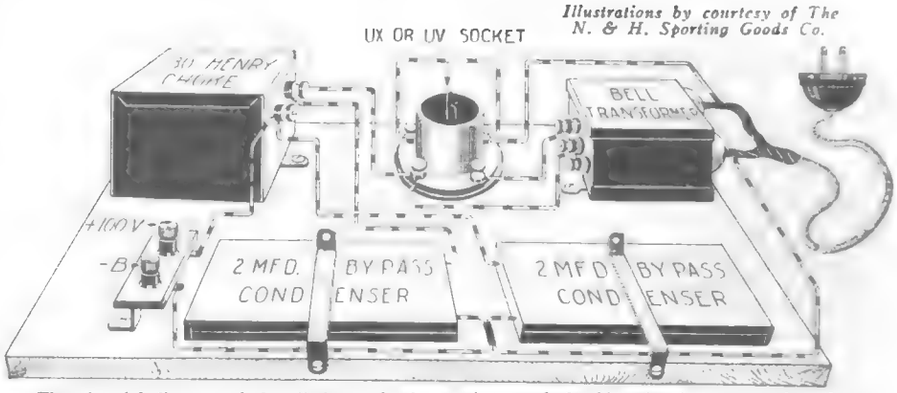
An Inexpensive "B" Eliminator

By ROBERT H. CROWLEY



The simple circuit diagram of the eliminator is shown above. It can be assembled in less than thirty minutes.

Illustrations by courtesy of The N. & H. Sporting Goods Co.



The pictorial diagram of the eliminator is shown above and should make the construction clear to the veriest novice. The base-board layout may also be followed but of course this is not necessary. One should note the utmost simplicity of the layout and the wiring of this eliminator.

THIS little how-to-build article is written especially for the small-set owner who likes the fun of building his own This small economical "B" eliminator has under laboratory tests operated very efficiently one, two, three and four tube sets without any noticeable trace of an A.C. hum. The writer after many inquiries for a small eliminator to operate this type of set and after trying many forms of half-wave rectifying and filtering systems, decided this circuit to be the simplest and cheapest for the novice to build, yet very efficient. During tests this little eliminator satisfactorily operated a three tube regenerative set at 100 volts on the plate.

One look at the circuit diagram given and you will note the simplicity of the circuit. The parts required are:

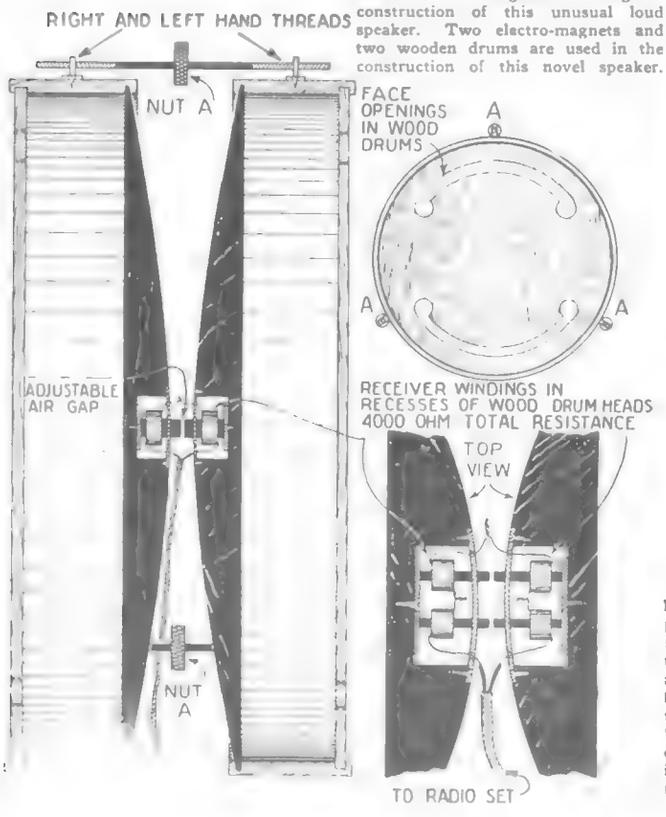
1—110 volt A.C. bell ringing transformer.
1—Standard tube socket.
1—30 Henry choke coil.
2—2 M.F. filter condensers—200 volts D.C. tested.
2—Binding posts.
1—Base board.

The wiring diagram is self-explanatory and easily followed. If the builder decides to use a separate detector voltage; as in a three-tube regenerative circuit, by placing a variable resistor and .002 by-pass condenser in the circuit (as dotted lines show) he can vary this voltage to suit the set. The filter condensers used are of the 200 D.C. working voltage type with no possibility of breakdown. You will note the grid and plate of the tube socket are simply shorted and joined to a common lead from the A.C. input. The writer has found the following tubes to give the best results: the Western Electric 216A, 101D and 205D; also the 216B half-wave rectifier; but as these tubes are not easily available, the home builder will find he will get very satisfactory results with the ordinary 201A type tubes; but for my own preference, not having the W. E. type tubes available, and for long tube life, I would prefer some type of ½ ampere power tube.

If after completing the unit, should you notice a slight hum, simply reverse the cord plug from the light socket; another good stunt which is widely used by "B" eliminator manufacturers is to ground all the metal cases of the condensers and choke.

Diaphragm-less Loud Speaker

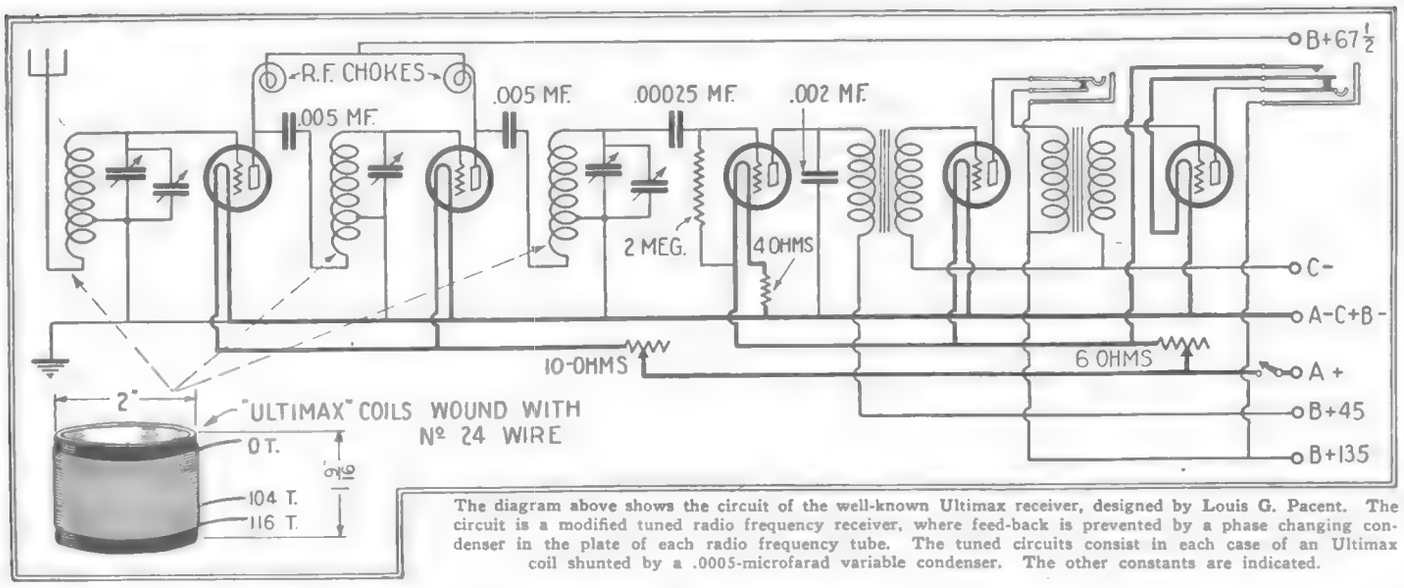
Below are two diagrams showing the construction of this unusual loud speaker. Two electro-magnets and two wooden drums are used in the construction of this novel speaker.



Above the inventor is shown demonstrating his new loud speaker which supposedly reproducts the sound by means of molecular movement and not by diaphragm action, the wooden boxes or drums merely acting as sound amplifiers. The new loud speaker faithfully reproduces voice and music over the entire range of audible sounds. The "Jirotka" speaker is of remarkably simple construction and is relatively inexpensive for it consumes only about one-half the energy needed to actuate an ordinary pair of head phones.

RADIO ORACLE

In this department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this department cannot be answered free. A charge of 50c. is made for all questions where a personal answer is desired.



The diagram above shows the circuit of the well-known Ultimax receiver, designed by Louis G. Pacent. The circuit is a modified tuned radio frequency receiver, where feed-back is prevented by a phase changing condenser in the plate of each radio frequency tube. The tuned circuits consist in each case of an Ultimax coil shunted by a .0005-microfarad variable condenser. The other constants are indicated.

THE ULTIMAX CIRCUIT

(531) Dudley Caverson, Rochester, N. Y., inquires:

Q. 1. Will you please publish the circuit diagram of the Ultimax receiver, designed by Louis G. Pacent?

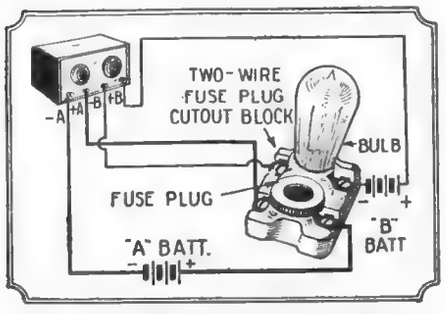
A. 1. You will find the circuit diagram of the well-known Ultimax receiver on this page, together with a drawing illustrating the winding data for the auto transformers used in the radio-frequency stages. The other constants are specified in the circuit diagram, where the values of the phase-changing condensers and radio-frequency chokes are indicated. This circuit has been found to be very efficient on the broadcast wave lengths, and is peculiarly characterized by its wonderful tonal qualities. The set is very simple to assemble and adjust and has proven to be quite a hit.

PUSH-PULL AMPLIFICATION

(532) Mr. Steven Jackson, Chiswick, Eng., asks:

Q. 1. What is the object of the push-pull method of audio-frequency amplification and what are its special advantages.

A. 1. Push-pull amplification is useful when proper power tubes, capable of handling large volume without distortion are not available. It enables two separate tubes to handle the last stage of amplification, each tube receiving half of the input. In order to divide the output from the preceeding stage, an audio-frequency transformer with a secondary tapped at its center is necessary. Or, alternatively, two audio-frequency transformers may be used, the primaries and secondaries being in series. The junction between the two secondaries can then be used as a mid-point tap, and is to be connected to the grid bias battery in the ordinary way. The remaining ends of the secondaries go each to one grid, the respective tubes thus dealing each with its own half of the output. It is usual to use another similar transformer, with a ratio of 1:1, for the output. The "B" battery positive is connected to the mid-tap of the transformer primary, the outer ends of which go to the plates of the two tubes.



One of the simplest methods of protecting the tubes of a radio set from being burned out is to place a current-controlling device in both the filament and plate circuits. Above, a 40-watt bulb is placed in series with the negative B-battery lead, with a small fuse in the A-battery circuit.

PROTECTING TUBES

(533) Fred Heenan, White Plains, N. Y., asks:

Q. 1. Can you recommend any simple method of protecting the vacuum tubes of a set from actually burning out?

A. 1. This very simple method would no doubt be of interest to you. As you will see from the illustration on this page, a device is shown which comprises a double-fuse block which is arranged with a bulb in one side and a small fuse in the other, the values of both the bulb and the fuse depending entirely upon the current requirements of the set and the safety margin which is desired. This may be easily figured out by estimating, in the case of the "A" battery, the current draft for the tubes used. The bulb used in the "B" battery circuit is simply there to limit the current flow and to prevent burning out the tubes in case the batteries are incorrectly connected.

D. C. FOR HIGH VOLTAGE ELIMINATOR

(534) Mr. Luther Steward, San Antonio, Texas, writes as follows:

Q. 1. Can you tell me of any way in which I may utilize the direct current lighting circuit of my residence to replace the "B" batteries for an amplifier using a 210 tube.

A. 1. If you have 115 volts D.C. running into your apartment or residence, there is little doubt that the line installation to your meter is a three-wire Edison circuit. In such a circuit, there are three wires run to the top of the meter box. The voltage across the two outside wires is 220 volts, while that of either of the other pairs is 110. The center wire is neutral relative to the outside leads. Therefore, a volt meter placed across the two outside leads will read from 220 to 240 volts D.C. If this voltage is impressed upon the plates of a 210-amplifier tube, it will be found quite sufficient to cause the tube to operate at highest efficiency. It will probably be necessary to install a filter system to reduce the line noises, in which case we would recommend any of the standard filter circuits. Various voltages may be drawn from this line by the use of a potentiometer of some sort, which will divide the voltage into those values required.

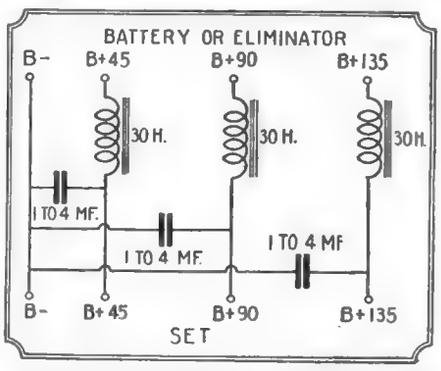
TUBE COMBINATIONS

(535) Mr. Marshall Austen, Athens, Ga., asks:

Q. 1. What do you recommend as the most efficient combination of tubes to be used in an audio-frequency amplifier?

A. 1. The answer to this question depends entirely upon the type of amplifier and the output desired. In the old days of radio, the only style of audio-frequency amplification which was used to any extent was the transformer coupled system. Transformers were comparatively inexpensive and fairly efficient so it became the custom to use them in all cases where tone amplification was required. In developing this type of amplifier, it was necessary to match the output impedances of the vacuum tubes to the average primary impedance of the transformers. This led to the development of the standardized transformers and the 201-type amplifier tubes. The later 201A-type tube is simply a modification of the older type, having a lower filament current consumption and considerably greater stability. This tube is adapted for use in radio-frequency circuits, as a detector with a fairly high plate voltage and in transformer coupled audio-frequency amplification when used in the first stage of a two-stage amplifier. For best results it is necessary to use some sort of a power tube in the output stage. Where two stages of transformer coupled amplification are used, the second tube may be either a 112-type tube, a 171-type or —if an exceedingly large output is required—a 210-type tube. The type 112 has a high amplification constant, and will carry a fairly heavy load. The type 171 is designed particularly for a large C bias to afford undistorted volume from large input. The 210-type is actually a transmitting tube, having an output of about 8 watts.

Where impedance coupling or resistance coupling is used in an amplifier, it is usually necessary to employ three tubes instead of two, to provide the extra amplification lost through the fact that transformers are avoided. For the first two tubes of an amplifier of this type, some type of hi-mu tube should be used. These tubes have a very high amplification constant and their impedance is adapted for use with high efficiency in connection with resistance and impedance couplers. The last tube should be a type 171 output amplifier which will furnish as great a volume as desired with undistorted clarity.



The circuit above shows the connections for a filter system which may be connected to the output of any type of B eliminator. This filter will serve to iron out line noises and fluctuations in voltage which might otherwise cause considerable trouble. Aged B-batteries will be helped by the use of such a filter.

A FILTER CIRCUIT

(536) George Murphy, Knoxville, Ten., asks:

Q. 1. Will you please illustrate in your department a filter system which may be adapted to any type of "B" eliminator to quiet the noises coming through from the line?

A. 1. You will find on this page a diagram of a typical filter system which has been found highly efficient. This filter system is made up of 30-henry chokes and 1- to 4-mf. condensers, three of each. It is absolutely necessary that the input and output sides be not confused, as a reversal of the filter will make it inoperative. This filter is adaptable to use with "B" batteries, to cut down any noises due to the age of the batteries, or with A.C. or D.C. "B" eliminators. Note that *this is not an eliminator*, but is simply a filter system to be applied to the output of any type of eliminator.

Scientific Humor

DID HE CUT UP-PER LIMBS TOO?

"How did you like your job in the woods?"

"Didn't like it at all. We had no sooner cut a tree down than we had to cut it up and so we did not seem to accomplish anything."—*J. R. Patterson.*

VERY TIDY

SHE: "Such nice clean sand on this beach."

HE: "Yes, it's washed twice a day by the tide."

LEFT ITS FOOT PRINTS

HE: "I see here in this magazine that a German entomologist says bees talk with their feet. What do you think of that?"

SHE: "Well, all I've got to say is that I felt one yesterday talking business quite convincingly with another part of his anatomy."—*F. J. Schwab.*

JUNO DIANA—SAW—US?

JUNO (the new geology instructor, very modern, young and conceited): "The head professor is putting my picture in a new geology text he is writing."

DIANA: "Yeh, what kind of fossil do you represent?"—*Wilder D. Foster.*

STRETCHING THINGS

WILLIE: "Pa, what is excelsior?"

PA (apartment raised): "Long sawdust, son!"

BEST FOR SOME!

SNARL: "What will you give me for my radio and loud speaker?"

COIL (who lives downstairs): "Twenty-five dollars more than it cost you, sawed, split and delivered!"—*Henry A. Courtney.*

ALSO ILLUSTRATED

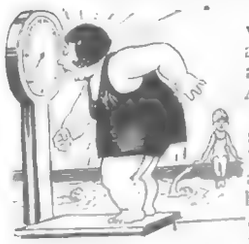
"Men, our iron age will always be with us. Proofs are on every hand. Our intellectual age is upon us and is destined to stay. Proofs are on every hand. . . . I challenge any man here to name an age I have not elucidated, that needs further details, that—"

VOICE FROM THE REAR: "Stew that. This is the gas age."—*J. Leo Vanderheyden.*

[How about the Gar-age? Printers' Devil.]

First Prize $3.00

REDUCING WEIGHT



An old, fat woman after reading a portion of Archimedes' Principle, shouted, "EUREKA" and plunged headlong into a neighboring pool. After the plunge she availed herself of a nearby scale and weighed herself again. She found she weighed just as much as before the plunge, so she shouted, "Achimedes is a damned liar. He had no sense when he said, 'A floating body will lose weight when immersed in water!'"—*Pascual Joson,* Rep. No. 23,771.

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. We cannot return unaccepted jokes. Please do not enclose return postage.

All jokes published here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to tie for the prize, then the sum of three dollars in cash will be paid to each one.

GIVE ME A PUFF

"I just bought a brand new oxy-hydrogen blow pipe today," said the first boy.

"Bring it out here. I've got some tobacco."—*Burl Knutson.*

RELATIVITY

TEACHER: "Willie, can you tell me why astronomical observatories are sometimes built on top of high mountains?"

WILLIE: "To be nearer the stars."—*E. A. Richon.*

MAY BE AMOEBA BROADCAST?

PROF. IN BIOLOGY: "What is a radiolaria?"

STUDE, whose mind is on the word RADIO: "It's a newly introduced sickness caused by RADIO. Its derivative is RADIO-MALARIA."—*Pascual Joson.*

WAS SCIENCE USED?

Two colored youngsters, who were to be paid for changing a large heavy tire on a truck, were seemingly having a difficult time lifting the tire. A bystander, noticing this, offered a quarter to the one making the nearest correct guess of the actual weight of the tire.

The first darkie to proffer his guess very confidentially said, "I'll bet dis here tire tips da scales at exactly thirty-five pounds."

Whereupon the other boy hilariously drolled his reply, "Man, dat shows how ignorant yo' is. Ah jest put seventy pound uh air in dat tire."—*H. H. Schroeder.*

AN UNCONSCIOUS SUBJECT

SOPHOMORE: "Did you ever take chloroform?"

FRESHMAN: "No; who teaches it?"—*Boyd Peugeot.*

A WEEKLING

HE: "Dearest, our engagement is off. A fortune teller just told me that I was to marry a blonde in a month."

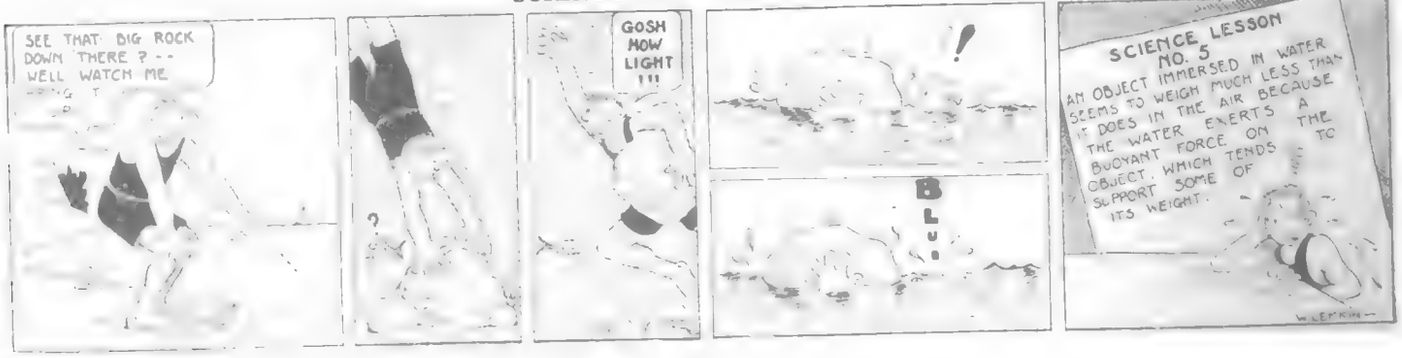
SHE: "Oh, that's all right. I can be a blonde in a week."—*Alex J. Lozouski.*

AND LESS PAINFUL

CLERK: "We are having a special sale of shaving sticks, Madam."

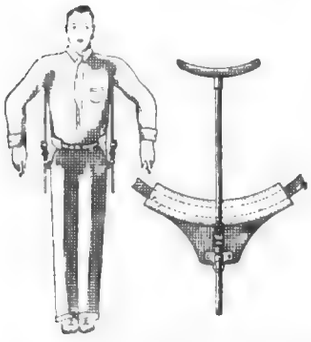
MRS. BARGAINS: "Oh, I'll take one for my husband: Rubbing his whiskers off with a stick will be so much safer than using a razor."—*Paul S. Powers.*

SCIENTY SIMON, SCIENTIST


SEE THAT BIG ROCK DOWN THERE ? -- WELL WATCH ME
GOSH HOW LIGHT !!!
!
BLUP!
SCIENCE LESSON NO. 5
AN OBJECT IMMERSED IN WATER SEEMS TO WEIGH MUCH LESS THAN IT DOES IN THE AIR BECAUSE THE WATER EXERTS A BUOYANT FORCE ON THE OBJECT WHICH TENDS TO SUPPORT SOME OF ITS WEIGHT.
W. LEFKIN

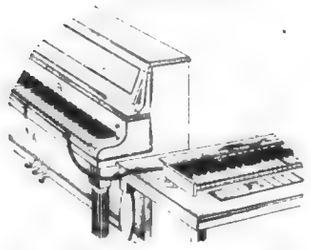
LATEST PATENTS

SPINE STRETCHER



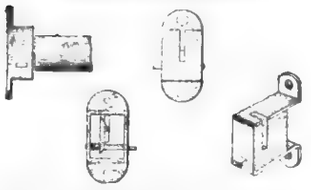
No. 1,614,641, issued to John R. Anderson. This invention is a spine stretcher for use in exercising both the spine and the muscles of the back, the intention of its inventor being that it will give results of a similar nature to osteopathic treatment. It consists of a pair of braces fitting under the arm and sliding in sleeves attached to the belt.

TEACHING MUSIC



No. 1,613,400, issued to Grace Ann McAleavey. This method is particularly adapted for teaching young children the fundamentals of accurately reading music. There is a staff board located in proper relation to the silent keyboard which in turn is connected with the piano. The keys on the piano close electrical circuits giving visual indications of the notes struck.

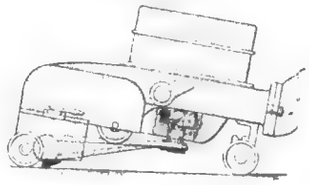
SHADE BRACKET



No. 1,611,688, issued to John C. Skala. In this particular system, it is impossible for the shade to fly out of its bracket and yet the bracket itself is no larger than the ordinary brackets. It will be observed from the back view that the shade upon being pushed into the elongated holder at one end, fits behind a spring catch which firmly holds it in place. To release, press the button.

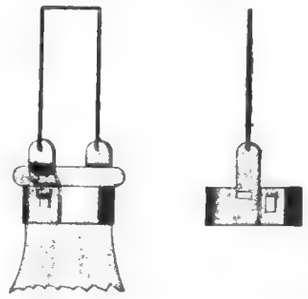
FLOOR POLISHER

No. 1,614,680, issued to Rodman C. Odell. This invention is primarily an attachment to vacuum cleaners in that a brush in a suitable holder is affixed to the bottom of the vacuum cleaner so that the brush can be revolved at high speed by means of the motor in the vacuum cleaner. The article is particularly adapted for the polishing of hardwood floors. It is obvious that any dust distributed by the polisher is sucked up by the vacuum cleaner.



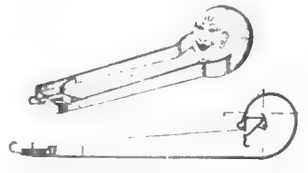
MILK BOTTLE CARRIER

No. 1,609,721, issued to Hoyt L. Husted. It will be observed in the illustration below that the milk bottle carrier may be quickly and easily attached to milk bottles. The clamp is a tongue which engages in a slot and which bights upon an upward pull of the handle.

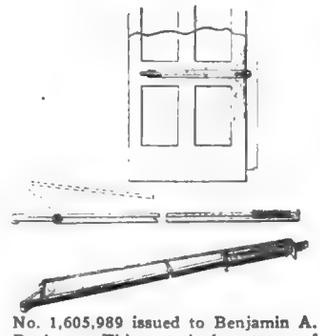


GAME

No. 1,615,218, issued to Henry Dupuis. In this particular game a marble or other game piece is placed in a spring gun and directed toward the head of the target. On reaching the interior of the rounded portion of head, the game piece is caused to drop down on any one of the baffle plates and may be returned to the player without scoring, or it may be projected through any of the openings in the head of the target, where it would score. In either event the marble is returned again to the player.

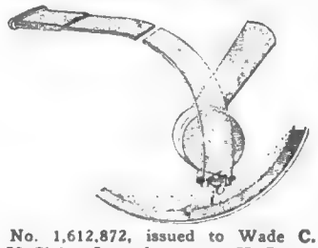


DOOR LATCH



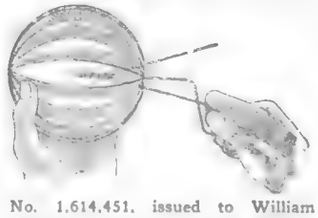
No. 1,605,989 issued to Benjamin A. Rucker. This particular type of door latch is primarily intended for the theatres and is of extremely simple construction, with a bar running across the entire width of the door. When the bar is pressed the latch is immediately opened and this permits the door to open and enables theatre patrons to open the door without turning bolts or latches.

PHONOGRAPH DENTIPHONE



No. 1,612,872, issued to Wade C. McClain. Several years ago H. Gernsback, the editor of these publications, devised an ossiphone which demonstrated that many deaf persons could hear via their teeth. Here is a similar but simpler mechanism enabling individuals partially deaf to hear phonograph records. The band from the reproducer is held between the teeth, and sounds are directly conveyed to the auditory nerve via the bones in the head.

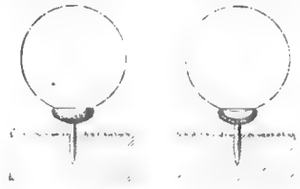
FRUIT MEAT REMOVER



No. 1,614,451, issued to William Barfield. By means of this peculiar shaped wire instrument, it is possible to remove the meat of citrous fruits by one motion. The rod is inserted at the apex edge of the dihedral angle between the side walls and pushed forward, the upright wires separate the fruit from its skin-like dividing partitions.

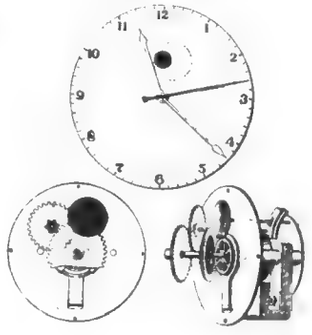
GOLF TEE

No. 1,614,343, issued to Lewis H. Broome. The inventor makes use of acorn cups for his golf tees. These are plentiful and cheap. They are fragile, may be readily carried and when struck by a player even if they fall on soil they will disintegrate and fertilize it without in any way detracting from the beauty of a lawn. The cup is of the proper size and shape to support a golf ball. The acorns will likewise cause no injury to a passing lawn mower.



ELECTRIC CLOCK

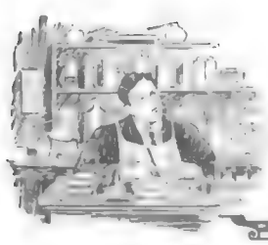
No. 1,615,664, issued to Henry E. Warren. This is a truly remarkable electric clock which keeps time to the second. It is operated like a synchronous motor, there being a small two-watt winding on a core provided with shading coils. A red indiator tells if the power has been shut down for any reason. This clock was fully described in a past issue of this publication.



TOY BOAT

No. 1,610,093, issued to Thomas G. Hitt. Below is a view of a paraffin paper boat. This is foldable and contains within it a balloon which may be inflated to obtain buoyancy. At the bottom there is a cartridge of explosive material which is ignited and this piece of fireworks exhausting beneath the surface of the water propels the boat forward. A smoke pot may be put in the smoke stacks and air from the balloon may also be utilized as shown.

NOTICE TO READERS. The above illustrated and described devices have recently been issued patent protection but are not as yet to our knowledge available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the above devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate Therefore, kindly do not request such information. —EDITOR



THE ORACLE

The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.

2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.

3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.

4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculations, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

STRANGE SHOCK KILLS MULE

(2161) T. D. & R. Co., Fort Smith, Ark., asks:

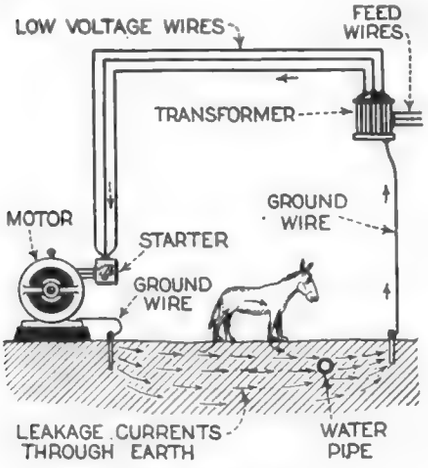
Q. 1. What is your opinion of a peculiar electric shock case which recently occurred just outside their factory in which case one of their mules was killed apparently by the leakage of electricity, due to what the power company claimed was defective ground wires in their establishment. On the opposite side of the street from the factory is a transformer giving a light and power potential of 220 volts for operating their plant. The mule was standing on the ground, and was not in contact with any wire or other metallic substance, when he fell dead. When the driver attempted to release the mule from the harness he was shocked severely. The other mule of the team was also shocked.

There is an 8-inch water pipe directly under the spot upon which the mule was killed, at a depth of about 4 feet in the ground. Directly over this spot the four wires of the 220-volt A.C. circuit carrying the current into the factory are about 15 feet from the ground.

There is a ground wire from the transformer to a point near the water pipe. In the factory are some 15 or 20 A. C. 220-volt motors rating from 1 to 35 H. P. These motors have plain switches for small sizes and oil compensators for the large sizes; all are grounded.

After the mule was killed a man could stand on the spot where the mule dropped and feel a distinct shock from the ground by holding the hands to the ground within 2 or 3 inches of the surface, and the farther apart the hands were held, the more distinctly the shock was felt.

Upon closing the switch, i.e., the main power switch in the building, the shock would be felt; with the switch open, the shock could not be felt.



The above diagram indicates how a mule can be killed even when standing on the open ground, without wires touching him.

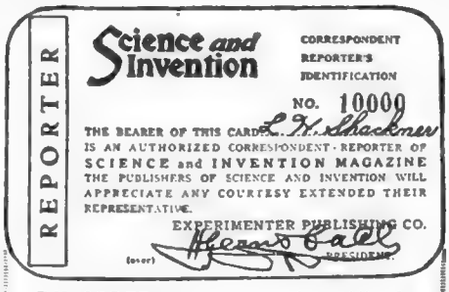
A. 1. This is a peculiar case, but in a couple of instances similar to this one, where an animal was killed by an electric shock, received while standing on the ground, the cause was due to a feed wire which had broken from the insulators on a pole line and had dropped down in contact with the earth. The ground being damp, a horse standing on a trolley crossing with at least one foot on the track and the other feet on the ground received a sufficient shock to kill it.

This is always a very peculiar case and offhand it does not seem that the argument you mention in regard to faulty ground wires in your factory, was or could be the cause of the accident in question.

About the best advice we could give you in a case like this is to procure the services of a local electrical engineer who could examine all the conditions in this peculiar case right on the spot, and if this engineer made a few measurements, it is possible he could point out the true cause of the trouble.

From the writer's experience it seems that horses, mules and in fact animals in general are markedly more sensitive to electric shock than are humans. Just why this is so is not definitely understood so far as we know. One reason possibly lies in the fact that horses and mules are usually shod with iron shoes nailed into the hoof, and this of course gives an extra good contact.

Another thought that we have in closing is that the leakage of electric current through the ground might have been caused by a "ground" on one of your electric motors or controller boxes, which allowed the current to find its way back via the earth, water pipes, etc. Also a breakdown in the insulation of one of the transformers supplying your factory would be quite likely to cause a leakage of current through the ground, especially if there was something defective in your electrical apparatus.



IN ORDER to present to the public the very latest scientific details, SCIENCE AND INVENTION maintains a large staff of field reporters. Any one of our readers is eligible to join this staff and, upon request, a reporter's card will be forwarded, together with complete instructions for gathering material. The reporter's card is illustrated above, and its use will gain admittance to many places that would otherwise be closed to the ordinary person. You need not have any special ability to obtain one of these cards other than a desire to help others to gain knowledge.

Address Field Editor, SCIENCE AND INVENTION.

Submitted manuscripts cannot be returned unless accompanied by postage.

TATTOOING MACHINE

(2162) Q. 1. Vernon Gale, London, Conn., writes to inquire if a tattooing machine may be constructed from parts available in his home laboratory.

A. 1. Some very successful tattooing machines are made by mechanically linking a needle or a series of needls to the armature of a large and strong buzzer. The needles are so arranged that the vibrating armature will cause the needles to operate with a reciprocating movement and thus create small punctures in the skin when applied threto. These hints should enable you to carry out the mechanical construction of the device for yourself. Ink of various colors is usually employed in tattooing.

DICYANIN SCREENS

(2163) Mr. Ludwig N. Hagley, of Los Angeles, Calif., writes:

Q. 1. Kindly furnish me with the specifications for a dicyanin screen such as that described in an article on the detection of the human aura.

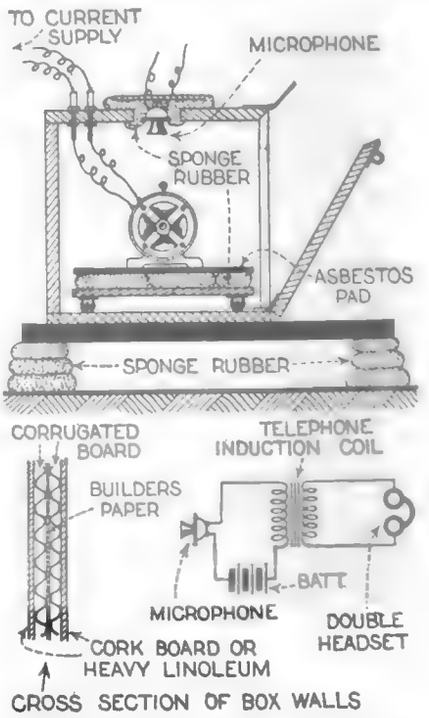
A. 1. The writer of the article to which you refer made some dicyanin screens, using celluloid dissolved in amylacetate cement, for binding the glass walls of the cell together. This solution is made very thick and the glass is clamped together in suitable clamps until the solution is hardened. The system employed used microscopic slides for the back and front of the screen. Thin strips of a slide were then cut out for the two sides and bottom, and a tiny glass wedge, tapering slightly, was used for sealing the top. The two sides and bottom were then cemented in place with the celluloid cement. The solution of dicyanin was then made with grain alcohol, although we presume that denatured alcohol will work as well. This was poured into the space between the slides in various concentrations, using a greater or lesser amount of alcohol, and employing a medicine dropper to fill the small space. Celluloid cement was then put on top of the solution and the wedge of glass jammed into place so as to seal the opening, the entire slide being passepartoued. By "light" and "dark" dicyanin screen, as indicated in the article mentioned, the author means a relatively weak or concentrated solution of the dye. To a drop of the dye a given quantity of alcohol was added to fill one of the screens. Then two drops of the dye were employed, then five, and so on. By putting one screen in back of the other, we were able to get different intensities of light. Our own experiments in observing the human aura did not meet with success. We have not as yet been able to see the aura.

A NOISE TESTING CHAMBER FOR MACHINERY

(2164) Mr. Walter Evarts, Toronto, Ont., writes:

Q. 1. We have occasion in our plant to test electric motors after assembly so as to locate poor bearings or improperly adjusted shims by the sounds produced when the motor turns over. Can you suggest a method by which we might eliminate outside sounds to facilitate this testing process?

A. 1. The usual method of testing machines of this type is to provide a soundproof chamber wherein the motor can be confined, with some method of listening for unusual sounds which indicate trouble. Such a cabinet is illustrated on this page, and we think that this design should fill your requirements very nicely. The cabinet walls are lined or packed with soundproof material, and it is arranged so that the motors may be easily put into and taken out of it. The door at the front of the cabinet falls to a horizontal position, and the rails upon which the motor carriage rests are continued on the inside of the front, so that a continuous track is provided which allows the motor to be rolled completely out of the housing. When the box is closed for test, the inspector places a pair of headphones on his ears, then starts up the motor.



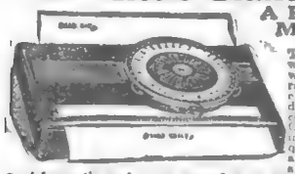
The diagram above shows how it is possible to test a noisy motor in a very noisy factory. The motor sounds only are picked up by the microphone and relayed to the tester who hears the noise in the earphones.

LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, **emits rays of white light**, rendering it **perfectly visible in the dark. THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match boxes, and innumerable other articles; make your own Luminous Crucifixes, Luminous Rosaries, etc. Bottle containing sufficient to coat several small articles, **Price 25c.** Larger sizes **50c** and **$1** postpaid. **Johnson Smith & Co., Dept. 367 Racine, Wis.**

The "Little Giant" Typewriter

A First Class Writing Machine For $1.50



A perfect little typewriter for **$1.50.** There are the thousands of persons who would like to use a typewriter but whose needs and business do not warrant the expense attached to the purchase and use of a fifty or seventy-five dollar machine. To such persons we confidently recommend our Little Giant. It is strongly made, but simple in construction, so that anyone can quickly learn to operate it, and write as rapidly as they would with pen and ink. The letters of the alphabet are arranged in a circle, enabling one to write rapidly, the punctuation marks being together. With this machine you can send your best girl typewritten love letters, address envelopes, make out bills, and do almost any kind of work not requiring a large, expensive machine. With each typewriter we send a tube of ink and full printed instructions for the machine. **Price complete $1.50 by mail postpaid to any address in the world.**

Every Boy His Own Toy Maker

Greatest boys' book written. Tells how to make a Pinhole Camera, a Canoe, model Railroad, a Telephone, Boomerang, Telegraph Instrument, Box Kite, Talking Machine, Microscope, Electric Motor, Electric Door Bell, Water Wheel, Paddle Raft, a pair of Skis, a Dog Sled, Bird House, Rabbit Yard, etc. 64 pages, 150 illustrations. **PRICE, 10c postpaid; 3 for 25c.**

GOLD TEETH

You know how fashionable it is to have gold crowns—if you can afford it. These gold-finished shells fasten over your real teeth and look like very wealthy fillings. Can be slipped on and off in an instant. Get some and surprise your friends. **PRICE 3 Cents Each, 3 for 15c, or 50c for 1 doz. postpaid.**

JOHNSON SMITH & CO., Dept. 367, Racine, Wis.

REAL PISTOL — Miniature Watch Charm Pistol

Exact reproduction of a real pistol; actually fires Real BLANK CARTRIDGES of miniature size. Illustration is actual size. 1¼ inches long, with ring at end for attaching to watch chain. Loads like a regular pistol. Pull the trigger and it goes off with a loud bang. Pistol is breech-open type; illustration shows position for loading. Made entirely of high grade steel, nickel plated, octagon barrel, handsomely engraved handles, complete in box with cleaning rod. **PRICE $1.75.** Also furnished with **pearl handles, $2.50.** **BLANK CARTRIDGES, 50c per box of 25.**

BOYS! BOYS! BOYS!

THROW YOUR VOICE

Into a trunk, under the bed or anywhere. Lots of fun fooling the teacher, policeman or friends.

THE VENTRILO

a little instrument, fits in the mouth out of sight, used with above for Bird Calls, etc. Anyone can use it.

Never Fails. A 16-page Course on ventriloquism, and the Ventrilo, ALL FOR 10c postpaid.

MIDGET BIBLE
GREAT CURIOSITY

Smallest Bible in the world. Size of a postage stamp. **200 Pages.** Said to bring good luck to the owner. A genuine work of art. Must be seen to be appreciated. Make good money selling them to friends, church acquaintances, etc. PRICE **15c** each, **3** for **40c, 12** for **$1.35, 100** for **$7.50.** Also obtainable in Leather Binding, with gold edges. **Price 50c each, 3 for $1.25, $4.50 per doz.** **Magnifying Glass** for use with Midget Bible, **15c**

K.K.K.

Everything about the **Ku Klux Klan** told in a clear, fearless manner. Book tells all How it started and was suppressed in 1871—The New Ku Klux Klan—How organized—How members are enrolled—Oath of the Klan—**Questions for Candidates**—Creed—Objects of the Order—Obedience—Fidelity—Pledge of Loyalty—**Ku Klux Klan and the Masons**—The Jews—The Masons—Real K. of C. Oath—The Negro Ku Klux Klan, etc., etc. Latest and most complete book on the Klan published. **Price, 35c,** postpaid.

SEX INDICATOR

Hold the **MAGIC INDICATOR** over a man's hand—instantly it moves in a straight line, backward and forward. Hold it over a woman's hand and it describes a complete and continuous circle. The same action can be obtained over a letter written by a man or woman, etc. It is fascinating; baffling. We have never been able to figure out how it's done—but we've never seen it fail. Many novel and entertaining feats may be performed with the Sex Indicator. For example, similar results can be obtained with animals, cats, dogs, rabbits, over birds, chickens, canaries, etc. Also used to predetermine the sex of chickens and birds, etc., in fact it is sold as a patented egg tester in Europe. **Price 25c, or 3 for 65c, postpaid.**

STAGE MONEY

With a bunch of these bills, it is easy for each person of limited means to appear prosperous by flashing a roll of these bills at the proper time and peeling off a genuine bill or two from the outside of the roll, the effect created will be found to be all that can be desired. **Prices, postpaid: 40 Bills 20c, 120 for 50c, or $3.50 thousand postpaid.**

Wonderful X-Ray Tube

A wonderfullittle instrument producing optical illusions both surprising and startling. With it you can see what is apparently the bones of your fingers, the lead in a lead pencil, the interior opening in a pipe stem, and many other similar illusions. A mystery that no one has been able to satisfactorily explain. **Price 10c, 3 for 25c, 1 dozen 75c. Johnson Smith & Co.**

Good Luck Ring

Quaint and Novel Design

A **VERY** striking and uncommon ring. Silver finish, skull and crossbone design, with two brilliant, flashing gems sparkling out of the eyes. Said by many to bring Good Luck to the wearer, hence its name, **Good Luck Ring.** Very unique ring that you will take a pride in wearing. **ONLY 25 CENTS.**

Exploding Cigarettes

JUST LIKE ORDINARY CIGARETTES, BUT SUCH REAL STARTLERS! The box contains ten genuine cigarettes of excellent quality. They appear so real, but when each cigarette is about one-third smoked, the victim gets a very great surprise as it goes off with a loud **BANG!** A great mirth provoker yet entirely harmless. **Price 25c per box.**

Popular Watch Charms

15c

ONLY 3 for 40c; $1.35 doz.

Very pretty little curiosities and decidedly novel. Fitted with Magnifying Lenses that enlarge the pictures to a very surprising degree; in fact, it seems almost incredible that a clear picture could be possible in such a small compass, and how sharp and distinct they show up when you look through. Come in assorted views—Actresses, views of Panama Canal, Lord's Prayer in type, etc.

CIGARETTE MAKER

Roll your own and save money. Makes them better and quicker besides saving more than half. Use your favorite brand of tobacco. Neat, useful and handy. Pocket size, weighs ½ oz. Made entirely of metal, nickel-plated. **Price 25c postpaid.**

MAGIC FLUTE

Wonderfully Sweet Toned and Musical

Post Paid **25c**

The Magic Flute, or Humanatone, is a unique and novel musical instrument played with nose and mouth combined. There is just a little knack in playing it which, when once acquired after a little practice will enable you to produce very sweet music that somewhat resembles a flute. There is no fingering, and once you have mastered it you can play all kinds of music with facility and ease. When played as an accompaniment to a piano or any other musical instrument, the effect is as charming as it is surprising.

Novelty Badges

Kissing Permit 10c *Garter Inspector 10c*

Two very novel metal badges, nickel plated, that you can wear, giving you fun out of all proportion to their trifling cost. **10c, each badge, 3 for 25c, or 75c per doz. p.pd.**

BLANK CARTRIDGE PISTOL

Price $1.00 Postpaid

This well made and effective Pistol is modelled on the pattern of the latest type of Revolver, the appearance of which alone is enough to scare a burglar, whilst, when loaded, it will probably prove just as effective as a revolver with real bullets, without the danger to life. It takes the standard .22 Calibre Blank Cartridges, that are obtainable most everywhere. Even the most timid women can use it with perfect safety and frighten a thief without risk to herself or anyone else. **A Great Protection Against Burglars, Tramps and Dogs.** You can have it lying about without the danger attached to other revolvers. We sell large numbers around the 4th of July. Well made of solid Metal. **PRICE ONLY $1.00 Postpaid. Blank Cartridges 22-calibre shipped by express only, 50c per 100. Johnson Smith & Co., Dept 367 Racine, Wis.**

Sneezing Powder

Place a very small amount of this powder on the back of your hand and blow it into the air, and everyone in the room or car will begin to sneeze without knowing the reason why. It is most amusing to hear their remarks, as they never suspect the real source, but think they have caught it one from the other. Between the laughing and sneezing you yourself will be having the time of your life. For **parties, political meetings, car rides,** or any place at all where there is a gathering of people, it is the **greatest joke out. Price 10c or 3 for 25c**

Mystic Skeleton

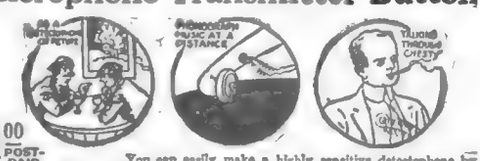
10c pd.

A jointed figure of a skeleton 14 in. in height, will dance to music and perform various gymnations and movements while the operator may be some distance from it.

Serpent's Eggs

Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which curls and twists about in a most lifelike manner. **Price per box 10c ppd.**

Microphone Transmitter Button



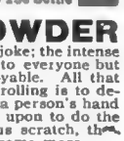
$1.00 POST-PAID

You can easily make a highly sensitive detectophone by using this Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. It is simple and inexpensive. You can install an outfit in your home and hear conversations being held all over the house. You can connect up different rooms of a hotel. This outfit was used by secret service operatives during the war. It is being used on the stage. It is ultra-sensitive and is the greatest invention in micro-phones. You can mount the button almost anywhere—card board boxes, stove pipes, stiff calendars, on the wall behind a picture frame, etc. Button is so light and small it cannot be detected. Persons can be overheard without suspecting it. You can listen in on conversations in another room. A deaf person in the audience can hear the speaker. Connected to phonograph, piano or other musical instrument, music can be heard hundreds of feet away. Button may be used to renew telephone transmitters; often makes an old line "talk-up" when nothing else will. The ideal microphone for radio use; carries heavy current and is extremely sensitive. Amplifies radio signals. Countless other similar uses will suggest themselves. Experimenters find the Button useful for hundreds of experiments along the lines of telephones, amplifiers, loud speakers, etc. Many fascinating stunts may be devised, such as holding the button against the throat or chest to reproduce speech without sound waves. $3.00 is given to anyone who sends in a new suggestion for the use of the Button proving the manufacturers find it suitable for use in their literature. **PRICE $1.00 POSTPAID ANYWHERE.**

ANARCHIST BOMBS

One of these glass vials dropped in a room full of people will cause more consternation than a limburger cheese. The smell entirely disappears in a short time. **10c a Box, 3 Boxes for 25c**

INVISIBLE INK



The most confidential messages can be written with this ink, for the writing **MAKES NO MARK.** Cannot be seen unless you know the secret. Invaluable for many reasons. Keep your postals and other private memorandums away from prying eyes. Great fun for playing practical jokes. **Only 15c Bottle**

ITCHING POWDER

This is another good practical joke; the intense discomfiture of your victims to everyone but themselves is thoroughly enjoyable. All that is necessary to start the ball rolling is to deposit a little of the powder on a person's hand and the powder can be relied upon to do the rest. The result is a vigorous scratch, then some more scratch, and still some more.

10c box, **3** boxes for **25c** or **75c** per doz boxes

LOOK 35¢ Look

Wonderful Instrument. Greatest thing yet. Nine separate articles in one. Everybody delighted with it. Odd, curious and interesting. Lots of pleasure as well as very useful. It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngascope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it. Sent by mail, postpaid. **Price, only 35c or 3 for $1.00 postpaid.**

RESURRECTION PLANT

One of the most wonderful plants known. Possesses the strange power of turning in a few minutes from an apparently lifeless, dry herb to a BEAUTIFUL LIVING FERN-LIKE PLANT of a dark green color. Simply place the plant in saucer of water, it will open up and start to grow in 20 minutes. When taken out it will dry up and go to sleep until placed in water again. Fine house plant—summer or winter. **10** cents each or **3 for 25c,** postpaid.

Agents Wanted

A DeLuxe Edition of our new 1927 CATALOG mailed on receipt of 25c. Handsome cloth binding. Only book of its kind. 550 pages of all the latest tricks in magic, the newest novelties, puzzles, games, sporting goods, interesting books, curiosities in seeds and plants, etc., procurable elsewhere.

ADDRESS ORDERS FOR ALL GOODS ON THIS PAGE TO

JOHNSON SMITH & CO. DEPT. 367, RACINE, WIS.

Postage Stamps Accepted

ELECTRICAL EXPERT'S OUTFIT

HERE ARE THE TOOLS that make money. Free, too, if you accept this special offer for S. of E. electrical training. Just a few happy hours each week at home means big success. Work that's full of thrills and fun. Send coupon for FREE book.

OUR MONEY BACK GUARANTEE BOND means that your training must absolutely satisfy you or every penny is refunded. S. of E. training makes good—with *you*. Our 23 years' experience has shown us the one right way for success. Mr. Harnischfeger, president of the Harnischfeger Corp'n, one of the largest electrical concerns in America says, "The best recommendation I have for your school is the number of your graduates who have made good in our organization. Their training is right."

LET THE OTHER FELLOW slave away at $25 a week. *You* get the real job with S. of E. training. Our men go to the Western Electric, Harrnischfeger Corp., Nordberg Mfg. Co., Allis Chalmers, and other big electrical concerns. Or you go into business for yourself and be your own boss.

In Business for Yourself

Hundreds of S. of E. Students locate for themselves with our help and make big money.

$65 A WEEK AND UP is just ordinary pay in electrical work. Even common electricians make that much. But with S. of E. training you can be an electrical expert and get the big job.

OPPORTUNITIES BY THOUSANDS every day. No slack seasons. The electrical boom is just starting. S. of E. men are demanded first because our 23 years' experience means better and more practical training for our students.

64 PAGE BOOK NOW FREE—send for your copy free and postpaid. Money Back guarantee ehatour course satisfies or money back. Mail coupon today without fail.

A Personal Challenge

"Whatever your present occupation we can train you for success in electricity. Put yourself in my hands."
Oscar Werwath, Pres.

Charles P. Steinmetz, A.M.Ph.D., 'Electric Wizard' of General Electric was for the last 6 years of his life on advisory board of S. of E.

CLIP NOW!

$65 A WEEK AND UP!

A chance of a real career in electricity for yourself. In business or rapid advancement with electrical concerns.

School of Engineering
Dept. 81-H427
Box 331, Milwaukee, Wis.

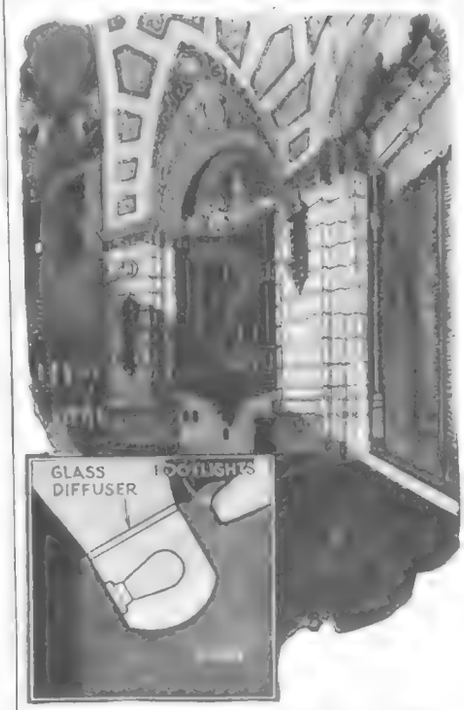
Please send me free and postpaid your 64 page book giving details of S. of E. training. Also details of your Money-Back guarantee.

Name .....
Address .....
City ..... State .....

Largest Theater in the World

By JAMES FRANCIS CLEMENGER

(*Continued from page* 1090)



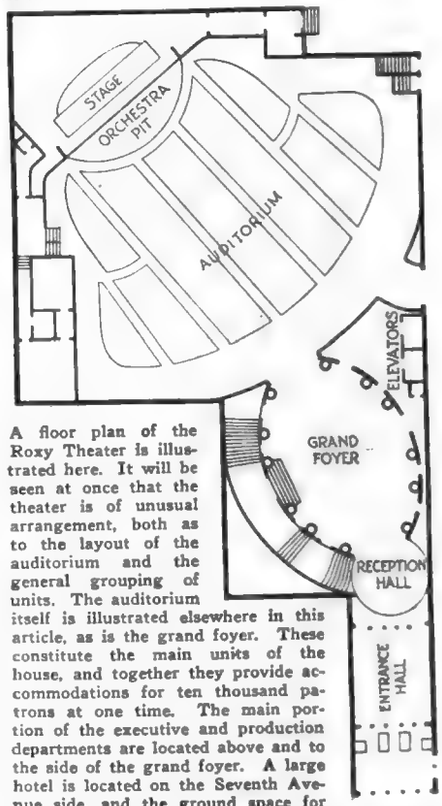
It was originally planned that the entire illumination of the theater be accomplished by an arrangement of lights such as that illustrated above. It was found, however, that somewhat more light was needed in the upper part of the theater than could be attained by this method. Flood lights were therefore placed in the highest portions of the ceiling, concealed behind decorative devices, where the general illumination might be increased without destroying the unique effect.

performance, and at that time he was powerfully impressed with the beauty of the interior decoration, even though it was to some extent obscured by scaffolding. Through the kindness of Mr. Douglas Murray, a personal assistant to Mr. Rothafel who acted as guide on two trips through the theater during the constructional period, we were enabled to obtain a large amount of information which would otherwise be unavailable.

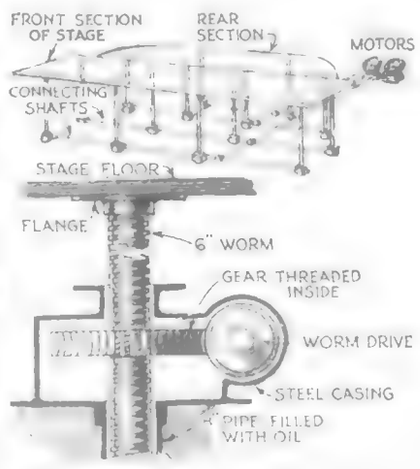
A few interesting facts were gathered during this last inspection trip, which are set forth here.

The distance from the floor of the auditorium to the center of the vaulted roof is about 120 ft. As a matter of peculiar interest we learned that, during the first stages of construction, a workman was knocked from the scaffolding at the top of the dome when his platform was struck by a falling crane. He dropped straight down to the concrete 120 ft. below—and when they went down to pick up the pieces they found that he was not even slightly injured. Roxy feels that this is a good omen and that it prophesies the success which is certain to come. As long as none of the patrons attempt to duplicate the unintentional circus feat of the lucky workman, the relation of this incident could do no harm whatever.

To add to the joy of the patrons, Roxy decided at the last moment to install the famous vitaphone system of talking movies, and they will be given a feature place on the bill.



A floor plan of the Roxy Theater is illustrated here. It will be seen at once that the theater is of unusual arrangement, both as to the layout of the auditorium and the general grouping of units. The auditorium itself is illustrated elsewhere in this article, as is the grand foyer. These constitute the main units of the house, and together they provide accommodations for ten thousand patrons at one time. The main portion of the executive and production departments are located above and to the side of the grand foyer. A large hotel is located on the Seventh Avenue side, and the ground space for the entrance hall has been leased for a number of years to pass through the property of the hotel.



The mechanism for raising and lowering the stage is very cleverly designed. Electric motors do all the work through a powerful train of gears, which move the stage silently and quickly.

Just as a final indication of the true magnificence of the decorative scheme of this wonderful theater, my readers will undoubtedly be interested to know that every square inch of the walls and ceiling of the auditorium of the Roxy Theater is completely covered with a layer of pure gold or silver leaf.

GEARLESS TRANSMISSION

In the February, 1927, issue of this journal on page 890 we illustrated a new British inventor's device in the form of a gearless, variable-speed apparatus, which we suggested might in time be modified or adapted to automobile requirements so as to do away with the present gear-shift.

We have received a letter from Mr. Louis C. Cattoi, stating that he took out an American patent on a practically identical system of variable speed transmission, the number of this patent being 1,421,908 which was issued July 4, 1922. Anyone interested in the problem of variable speed transmissions of a positive type will do well to study the article we published in the February issue, as well as the patent specification and claims of Mr. Cattoi.

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DRAWING INSTRUMENTS

(1009) Howard Woods, Manitoba, Canada, submits a sketch of an oval drawing tool and a flexible curve. He requests our opinion.

A. We are of the opinion that your oval drawing machine is too elaborate for daily use and rather too expensive to market. No doubt a market could be made for the machine capable of drawing ovals of any width or length, but the mechanism should be simple, instantly adjustable and inexpensive.

With reference to your curve-drawing tool, we would suggest that the style of your particular device is not new nor is it advisable. The simplest device of this nature which we have seen consists of a sheet of rubber joined to a sheet of metal, the metal sliding over rubber and the rubber itself holding the metal band in place.

We do not suggest a patent on either of your systems.

PROTECTING IDEAS—PRIORITY CLAIMS

(1010) W. H. Wallace, Sask, Canada, asks about publishing an idea to protect it.

A. Publication of an idea in a magazine is not a protection. It merely establishes a claim of priority, but it is not necessary that the idea be published in a newspaper or a magazine in order to get such "priority of conception" evidence.

We would suggest that you draw the plans of your invention on a sheet of paper and also place on that same sheet a complete description of the device, showing how it is to operate, and what it is intended to do. Show this paper to as many of your friends as you care,—the more the better, and have each one sign his name on the bottom of the paper. Also place thereon the date on which they saw the particular drawing. In this way you will have established a good claim of priority.

Reduction of the invention to practice is another method that should always be employed wherever possible. This constitutes the building of a model, which you should then photograph and have the photo sworn to before a notary public. This is merely for the purpose of securing a record of the date of the photograph. Keep the specified photographer's bills and model maker's bills.

A third system would be to take duplicates of both of the previous methods, place them in an envelope so that it can not possibly be opened without breaking the seals. This envelope should be mailed to yourself, and you should be sure that the stamp cancellation date is very clearly impressed on this envelope. Under no circumstances should this envelope be opened except in court, in an effort to establish priority.

HOUSEHOLD ARTICLES

(1011) William L. Conner, Dayton, submits suggestions for a potato peeler, potato slicer, bread slicer and biscuit cutter.

A. 1. We do not consider that any of your ideas are practicable. In all of them you have merely combined a plurality of knives, instead of one knife to accomplish the purpose.

In the potato peeler and possibly even the bread slicer, this is detrimental. In the biscuit cutter, the device is slightly more practical but not new and probably cannot be patented. The potato slicer impresses us as old and obtainable in both this and the honeycomb form, in the average five-and-ten-cent store.

We would not recommend applying for patents for any of the things suggested.

CARBURETOR GAS-AIR SUPPLY

(1012) Horace Lemaster, Maryville, Mo., asks for our opinion on a carburetor to feed more gas vapor to the engine, the regular carburetor to be connected to the air space above gas level of the tank. In this way gas-laden air is to be drawn into the carburetor instead of pure air.

A. 1. If we desire to feed gas-laden air to the carburetor, we could do so by simply cutting off the air value and forcing the pure vapor of gasoline into the engine. Unfortunately for your invention, unless gasoline is properly mixed with air, it is non-explosive and that is why carburetors are as intricate and contain as many controls do. Your idea therefore of using the gas-laden air found in the gasoline tank is not practical because its saturation would be variable at all times; because the installation is dangerous and because a back pressure would be produced, preventing the gasoline from feeding to the carburetor properly. The suggestion is entirely without approval and we do not recommend that you apply for a patent on the same.

COMBINED ARTICLES

(1013) Charles C. France Watsontown, N. J., asks three questions, the nature of which is made clear in the answers.

A. 1. In regard to your communication, the combining of three devices to be used for a different purpose does not necessarily supply a claim for a patent, and we doubt very much if you can secure one.

Many an idea has been sold without being patented, and without the necessity of making a model. Keyless locks are old and combination locks, as well as locks which will work by secret methods have been on the market for a great many years, consequently we do not know whether or not the particular style of lock advanced by you is practical. We would suggest that you build a model and send it to any of the larger lock manufacturers to determine the possibility of selling such an article.

You could hardly get a patent on an automobile jack (which can work on only the rear wheel but not on the front wheels) even if that individual discovers a way to make it work on the front wheels. We have not to this day seen any jack which could not work on both front and rear wheels of an automobile. It is obvious that a tire on the front wheel must be changed nearly as often as one on the rear wheel, and consequently any jack which cannot operate on the front wheel would be a market impracticability.

POLE RAISER

(1014) Albert McDowell, Los Angeles, Calif., submits a suggestion for raising telegraph poles.

A. 1. We do not see that your device is practical, and we do not believe that it is as good as the ordinary donkey pole method of raising telegraph or other poles, your system being more cumbersome and less speedy in operation.

Even though the idea may be patentable, we would not suggest that you apply for a patent.

(*Continued on page* 1148)

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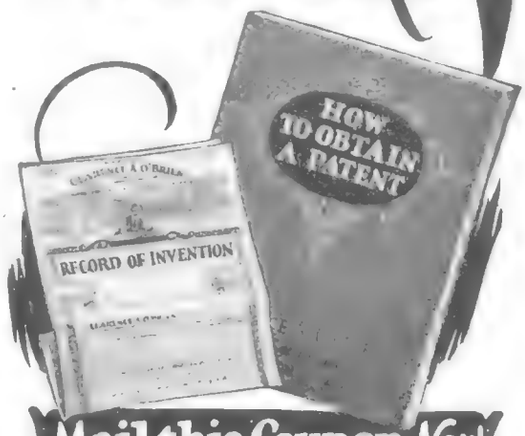

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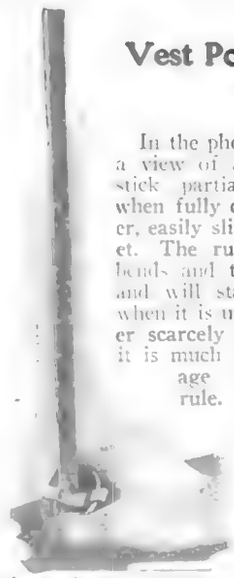

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Kinks for Experimenters

By RAYMOND B. WAILES

(*Continued from page* 1127)

A tapped hole can be made in a hard rubber radio panel by first making an undersized hole in the panel with a red hot wire or nail and then while the rubber is still soft from the heat, screwing the machine screw into the hole and allowing the panel to cool. The screw can then be removed, the burr scraped off, and a perfect tapped hole will result.

Panel type voltmeters or ammeters can be made into the portable or table-top type by fastening brass brackets to them and bending the brackets so that a sloping position is had.

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ELECTRICAL AND MECHANICAL EXPERT

Into the Fourth Dimension

By RAY CUMMINGS

(*Continued from Page* 1109)

and machine guns, and war-vessels alert to destroy them.

I told myself that there was nothing to fear. I had thought of escape. Desperately I would try to rejoin Will and Bee that we might do something to stem this invasion. Or escape, and get up there to Earth, to tell the authorities what I knew. But sober reason told me that as yet I knew very little. I had best stay with Brutar, to learn what I could.

We passed under the length of Manhattan; came at last to lower Broadway. We were close beneath it. The great shadowy piles of masonry towered above us. Looking upward I could see through the shadowy outlines of the foundations of the buildings; strata of rock; the subway tunnels; to the right the tubes leading to New Jersey beneath the river; the net-work of water mains; gas; light; telephones; the myriad underground arteries of the city. And I could see up through the sub-cellars, the cellars, and into the buildings themselves.

"He strode vigorously at the intent and curious soldier—passed through him; but the soldier did not move."

Towering structures with all their anatomy laid bare as though some giant X-ray were turned upon them.

We stopped; gathered in a group. We were just beneath City Hall Park, standing partly within one of the Subway tunnels. No trains were running. Soldiers were massed on the station platform. They came along the tracks—transparent ghosts of uniformed, armed men—came until some of them passed directly through us; and stood nearby, grimly watching and waiting.

In the empty park overhead, policemen were on guard, and troops were bringing in machine guns. I could see, too, that soldiers were now massing on the shadowy Brooklyn Bridge; police boats were clustering on the river there; and armed men were waiting in the cellar of every building near by. There were towering giants of buildings all about us here. . . . The Woolworth Building was close at hand. . . .

Brutar said, "I should not care just now, to materialize further, Rob. These men look very determined." His laugh was ironical. "They are watching us closely—much good it will do them!"

He called his little band of fighters to him; they stood partly on the Subway tracks and partly beneath them. And he gave his low-toned instructions.

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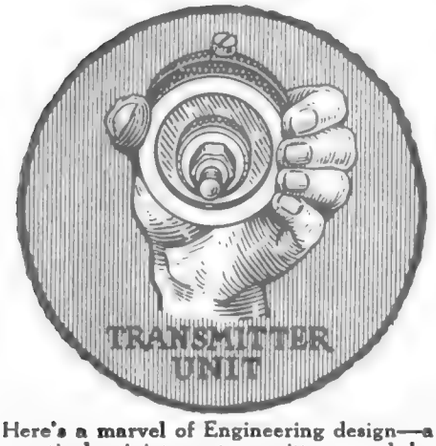

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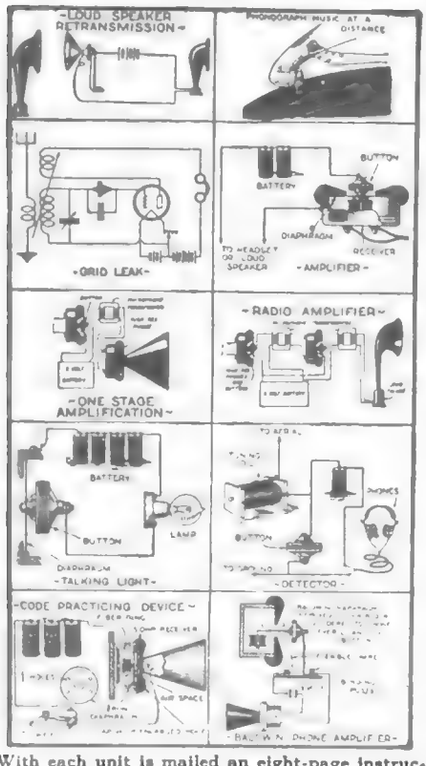

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I saw ten of his men move aside as he indicated them. "Yes," he said. "You first. And I think I would work upon that largest house over there."

Silently, with their ghostly glowing bricks in hand, the ten advanced. Across the Subway tracks, through the spectral earth and rock strata under Broadway. Climbing or floating upward, I could not tell. Moving through and into the vitals of the Woolworth Building

CHAPTER XVI

THE ATTACKING SPECTRES

I SAID to Brutar, "You asked my help. But you have let me do nothing to help you—and you explain nothing, so that I have no idea what is going on. Am I not enough your friend by now?"

Brutar smiled; I think he was fatuous enough to believe that he had won me over.

"You will be able to help me, Rob. We're going to place these weapons everywhere. There is a statue near here somewhere—a giant figure rising from the water. I want you to lead us to it. Later—when we have finished with this great house."

"Weapons?" I echoed. "What sort of weapons?"

He continued to smile. "You called them bricks a while ago. That's what they are—inert material we brought with us. I had devised other things, but thought that these would suffice. Come here—I'll show you."

He took one of the bricks. As I stood with him to examine it, a score of the ghostly troopers came across the Subway tracks and fronted us.

It was a light substance, but quite ponderable. Solid, yet rather of the consistency of soft rubber; I seemed to be able to mould its shape slightly with my fingers. Blue-green of color or silver phosphorescence; and it glowed and shimmered in my hands.

I gave it back to Brutar. "You're going to place these—where?"

"Everywhere," he said. "You shall see. Let us go watch my men place them up there in the great house. . . . This fellow is very bold! He doesn't seem afraid of me!"

He strode vigorously at the intent and curious soldier—passed through him; but the soldier did not move.

"Come, Rob—let's go up and watch them."

We moved under the Woolworth Building, up to and through the bottoms of its great elevator shafts. And climbing—upon what I cannot say or guess—we passed upward and into the building. Through its walls; its skeleton framework of steel; floating back and forth through its many storied offices. . . . Roaming ghosts!

The ten ghosts of Brutar were floating silently about. We ourselves could be seen by those within the building—seen as spectres hovering, moving with what silent, sinister purpose they did not know.

Yet they tried to resist us. We came, for instance, upon one of Brutar's men, with the brick still in his hand.

"Shall I place it here?" he asked. "We have chosen this side—I thought this might be a good spot."

We were some four stories above ground. Before us was one of the great upright girders of the structure.

"I should think so," Brutar agreed.

The man held the glowing, oblong brick within the shadowy steel. He released it, and it floated gently downward—wafted down like a feather very slowly. But it kept within the outlines of the girder.

"You'd better follow it," said Brutar. "It will stop presently—and perhaps where you want it."

Inside the building the Earth-people had seen us—we three hovering there. Men and soldiers were running from room to room, and up and down the staircases trying to get near us. There was a room and a portion of a hallway close to where we now hovered. They were soon thronged with men, crowding against the walls, within which our white shapes were visible. But the walls, solid to them, stopped their advance. They stood regarding us; and now I could see fear upon their faces as their glances followed the downward floating brick. And as it descended a story, many of them rushed down, scrambling against the walls, striving to reach into the place where they saw it.

Did they divine its purpose? I thought so; for as presently it came to rest, lodged in the upright steel where cross girders were riveted, I saw men come rushing with crowbars and axes. Frantically they were tearing at the walls, ripping out the wood and plaster, striving to reach and perhaps to dislodge that shimmering thing lying there in the vitals of the building.

Brutar laughed. "You see, Rob? They're beginning to understand now—and they're frightened. *It is materializing*—that brick, as you call it, is materializing!"

Growing solid! In a surging torrent of horror complete realization rushed over me. I scarce heard Brutar's gloating words: "That inert matter, freed of physical contact with our Borderland bodies, tends slowly to change to the state of the thing nearest to it. As heat by contact communicates, so

"Brutar laughed. 'You see, Rob? They're beginning to understand now and they're frightened. It is materializing—that brick, as you called it, is materializing!'"

does the vibratory rate of all substances. That brick, lodged there, is materializing. Slowly now—but soon very fast. Presently it will be as solid as the steel girder itself—a brick resting there complete in your Earth-state—demanding space of its own, for its own existence!"

Space of its own! What diabolical force of Nature would this unleash! These molecules, atoms, electrons of the steel and brick thus intermingled! In a Space but half sufficient! A force created of unknown, unthinkable power—immeasurable as that proverbial irresistible force meeting an immovable body. Two solid bodies here, intermingled to their very essence, striving to occupy the same space at the same time!

Brutar was drawing at me. "Look at them, Rob! Trying to get at it! And up there—and down below—see them?"

The glowing bricks were lodged up and down the building—all seemingly on the one side. Down underground, lodged in the very foundations of the structure I could see three of them piled together. And frantic shapes of men digging for them through the walls of the cellars.

"Come further away, Rob. We can see it better from a distance. It should be very interesting."

We retreated, going back until again we were standing just beneath the level of City Hall Park. Brutar's men gathered around us—two hundred ghosts clustered there watching the fruit of their diabolical efforts. There were soldiers with machine guns in the park. The guns impotently, ridiculously were trained upon us. And around the edge of the park a cordon of police kept back the crowds. I wondered what time of night it might be. Evening, possibly; and then I saw the spectral clock of the little tower of the squat City Hall. It was just before midnight.

Our march, perhaps not so much sinister as weird to the public, had drawn a jam of the morbidly curious to this part of the city. They were packed everywhere. And all the normal activities of the city were stopped. No traffic on the streets. Vehicles motionless.

The great Woolworth Building stood like the ghost of some grave giant, serene, majestic in the power of its size. Its summit up there in the gloom seemed lighted; spots of blurred light were everywhere within it.

The whole scene of shadows seemed unreal. Like a dream. But as I saw those frantic figures scrambling within the threatened building, hacking futilely at its foundations to try and remove in time those dim, glowing bricks materializing from another realm—the stark, strange reality of it all was forced upon me.

We waited. How long I cannot say. Spectators of two realms, each to the other mere ghosts, standing there watching and waiting. For a time nothing happened throughout all the scene. And then a change was apparent in the crowds about the park. No longer were they watching us, the ghosts, but they were eyeing now the Woolworth Building. At first curiously, incredulous to believe the news which was spreading about. Then restlessly, and then, as orders evidently were passed to the troops and to the policemen, these began pushing and shoving at the people. The crowd resisted at first; moved reluctantly. Then a fear seemed to surge over them—fear growing to panic. They began trying to run—waves of them everywhere surging in panic away from the doomed building.

Hundreds went down underfoot, trampled upon in the streets by their fellows, mad, insane now with fear. And from every nearby building its occupants came tumbling out like frightened rats; scurrying out to join the panic of the streets. A chaos everywhere . . .

And we ghosts stood quiet and serene in its midst.

Brutar murmured, "Watch the great house. They know it is doomed. See, they have stopped their efforts in there—now at the last, trying to save themselves."

The Woolworth Building was emptying . . . Abandoned . . .

Breathlessly I stood and gazed upon the ghostly scene. The tremendous building towered there motionless. But presently I fancied it stirred; its graceful roof up there seemed swaying . . . Shifting . . . Or was it a trick of my straining vision? But then I saw it was not, for palpably the tower swayed . . . Leaned. Further—leaning until all at once I knew it could not recover . . . Poised, and then was toppling.

A breathless instant. Slowly at first, like a felled forest giant, the great structure was coming down. Slowly, then with a rush it fell to the south—fell in great shattering segments. Crashed with a soundless crash upon the several blocks of nearby buildings. Crashed and tore with the thousands of tons of its weight, smothering everything beneath its crashing masonry and steel. . . . A soundless chaotic scene of ruin and death over all those city blocks, with huge rising clouds of dirt and smoke mercifully to obscure it.

(*To be concluded*)

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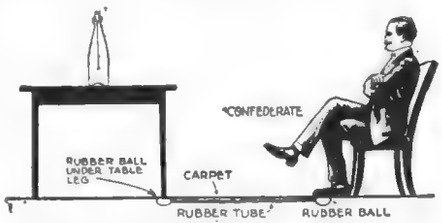
Our Spiritualistic Investigations

By DUNNINGER

(*Continued from page* 1105)

been previously seated carelessly about the room, began to adjust their chairs. With military promptness, they re-arranged them, until we were seated in a circle. In the center of the room stood a small mahogany table. In the center thereof stood a bottle, of the usual type. A cork had been forced into the neck of this container, from the top of which hung a short string. To the free end of this string was affixed a small ball of lead, scarcely larger than a pea. A colored lady entered the room, and, picking this bottle up from the table, began to walk about, and pass it to the various spectators, asking them to examine it if they chose to do so. Little interest was displayed in this examination by the various visitors, probably due to the fact that they had often previously examined the bottle, and were now contented that the apparatus was genuine, and precisely what its appearance suggested.

Being a newcomer to the mystic circle, I, of course, was more than curious, and found myself looking the apparatus over with a greater amount of suspicious interest. Keen examination proved that the bottle, and its arrangement, was quite in-



The above diagram illustrates how the pellet in the bottle is made to swing back and forth and strike the sides of the bottle. It will be observed that the article known as the plate lifter is beneath one leg of the table and by causing the table to move up and down, the motion is transmitted to the bottle.

tact, and free from any apparent form of trickery. Smilingly, my friends looked at one another, seemingly amused at the satisfaction my facial expression emphasized. The bottle soon found its place back again upon the center of the table top.

The dark skinned attendant turned off all the electric lights, including those in the chandelier overhead. One lone globe, embedded in a small oriental lamp, of unique design, was left burning. This lamp stood in one of the corners of the room, and was about eight feet away from the chair upon which the medium was seated. Aided by the music of a phonograph, the guests sang two or three hymns, the names of which the medium suggested. Although a stack of hymn books were scattered about on a table in the corner of the room, it seemed that none of the guests required them, as they all had been there so often, that they were familiar with the words. When the singing had subsided, the little lady, in a sweet, pleasing voice, proceeded to offer a short talk on her unusual powers, and explained that an Indian mystic, who many years ago had entered the land of the great unknown, was her guiding spirit, and was present in the room. She explained that he would answer all questions through her mind, and would give her the power of moving the lead weight (which dangled from the free end of the string), and strike the side of the bottle. These taps would be an

(*Continued on page* 1156)

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Are Your Tonsils and Sinuses Healthy?

By H. W. TOWNSEND

(*Continued from page* 1095)

hollow air chambers, will resonate or give forth certain sounds in each case. The physician who is familiar with this method of diagnosing the condition of the sinuses, listens with a stethoscope and proceeds to hold the exploring end of the stethoscope over the various sections of the face adjacent to the respective sinuses. Once the physician has become experienced with this method of diagnosis he can tell in a moment whether a sinus "sounds" healthy or sick. Naturally, a healthy sinus, being a hollow air chamber, will give a strong vibrant note in the stethoscope; while if, due to an inflamed condition of the sinus, there is any pus present, the sound heard will be of a more or less dull tone.

There is apparently but one way to find out whether a tonsil is absolutely healthy or diseased, especially where the tonsils appear perfectly healthy, and that is to apply suction to the tonsils. The throat and nose specialist today has a small vacuum pump, driven by an electric motor, and he sterilizes and heats up a glass tube, which he passes through the mouth and presses against first one tonsil and then the other, withdrawing the tube from the tonsil in each case and examining it to see if there has been any pus withdrawn. If there is any pus drawn from the tonsil in this way, it usually indicates that the tonsil should be removed.

Tonsil operations used to be more or less dreaded, but they have become so commonplace nowadays that people do not worry very much about them. The operation is now accomplished in a great many cases with local anæsthetic, and the patient sometimes has the operation performed in his own home or else he goes to a hospital for a day or two. The most important thing in tonsil operations is to be sure that the patient's blood coagulates properly, in order to be certain that trouble will not be encountered later due to more or less severe hemorrhages. The conscientious surgeon will proceed to make certain that the patient's blood has sufficient fibrinogen in it to cause proper coagulation. There are several methods available for making the coagulation test by the aid of a drop of the patient's blood, obtained from a simple needle prick, but one of the cleverest methods is that involving the use of the apparatus here pictured, and known as Boggs' modification of the Brody-Russell

Articles In April "Radio News"

Super-DX Reception — By Herndon R. Green

The Evolution of the Browning-Drake Receiver — By Arthur H. Lynch

A Complete "A and B" Socket-Power Unit — By R. E. Lacault

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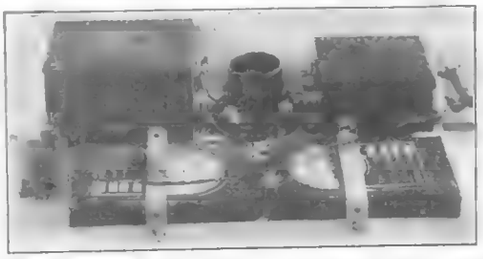

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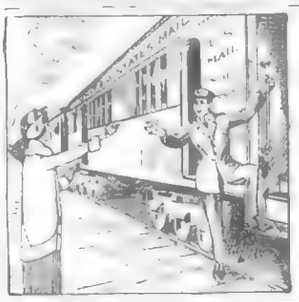

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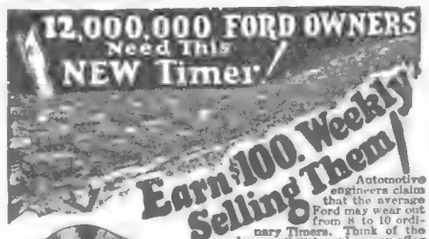

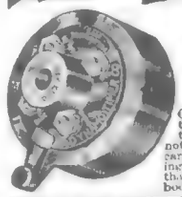

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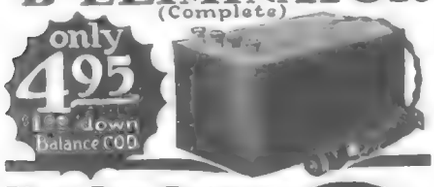

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instrument. If the coagulation blood test is negative and there is danger of the prospective patient suffering from hemorrhages after a tonsil operation, then the patient is given certain chemicals for a short period to build up the coagulating property of the blood.

TESTING COAGULATION OF BLOOD

The most practical coagulometer is probably the Boggs' modification of the Brodie-Russell instrument. The instrument consists of a round metal chamber with a glass bottom. A truncated cone of clear glass, the free surface of which is 4 millimeters in diameter, fits into this chamber from the top. A capillary metal tube projects into the chamber from the side in such a way that the point is just below the free surface of the truncated glass cone. This tube carries a small rubber bulb and tubing, of the kind used for operating the shutter of a camera, on its outer end. The chamber is placed on the stage of a microscope, the rubber bulb and tubing being in place, The free surface of the truncated glass cone is then touched to a drop of blood exuding from a puncture made in the usual manner, and is then placed in position in the chamber. The two-thirds lens of the microscope is then focused on the drop of blood, and gentle pressure is made on the rubber bulb, so that a fine jet of air plays on it. At first the corpuscles are seen moving separately parallel with the circumference of the drop, then in clumps parallel with the circumference of the drop, then with an elastic movement forward and backward parallel with the circumference of the drop, and finally radially inward and outward from the circumference toward the center of the drop. When the latter movement is obtained, coagulation is complete. The time at which the blood begins to flow from the puncture and the time at which the radial elastic movement above described should be noted, the difference between the two being the time necessary for coagulation. The average time necessary for coagulation in normal individuals is about five minutes and six seconds.

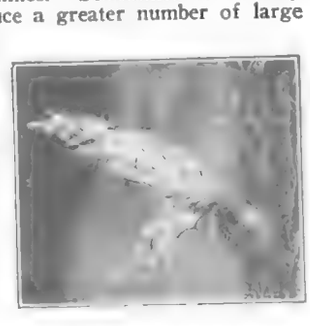
Cultivating and Propagating the Cactus

(*Continued from page* 1102)

Echinocactus engelmanni. The cactus itself is much ribbed and densely covered with spines. It is a form not especially easy to cultivate.

with soil. During the process of transplanting it is advisable to wear leather gloves, especially if thorny cacti must be handled. If the plant has formed buds, it is best to wait until the flowering period is over before transplanting. When this process has been accomplished, water should not be given, as it is best to wait a few days so that injuries, which may have been caused, have a chance to partially dry out.

Thin-stemmed, much branched cacti are often grafted upon thick stemmed species. This produces plants having flowers of different species upon one trunk which flower at different times. Sometimes it is only done to produce a greater number of large flowers, at other times for the purpose of forming a unique and weirdly shaped plant. Such forms are produced by grafting a spherical cactus upon a tall, slender species.



Cereus baumanni. Other forms of cereus produce showy flowers, but this form has a more or less tiny one, the smallness of the flower being offset by the vivid red color which lifts it out of the fresh green of the cactus.

As a rule only those species of cacti are grafted which do not produce a well-defined stem or trunk as species of Epiphyllum, which are often called Christmas cacti, as they flower during December and January. The process of grafting is comparatively simple. The stock receives a cut about half an inch in length and in this slit a segment or internode of, for instance, Epiphyllum which has been slightly pointed, is introduced. It is not necessary to bandage the union, although a woolen thread can be loosely placed around it so that the scion will not fall out of the slit in the stock. Some amateurs simply stick a thorn of Peireskia through the stock and scion like a needle. The grafted plant is then placed in the light. Cacti having root troubles are often saved by this method of grafting.

The simplest and quickest way to propagate the cactus is through cuttings or through regenerative buds. These grow quite rapidly into larger plants, as they quickly develop a good root system if planted in a pot containing a sandy soil. The cuttings or internodes should not be planted before the cut or broken part has been thoroughly dried, which should be accomplished in the sun. The sandy soil in the propagating dishes must be kept reasonably dry, that is, it should not be too moist, and the pots are to be placed in a sunny window.

Propagation through seeds does not lead to such quick results of course, but it is an interesting study which can easily be followed in the window garden. The seeds are to be sown during the early spring, in vessels containing a sandy leaf mold and provided with a foundation of pot-sherds. The vessels are filled with soil to a half an inch of the top. The seeds are sparingly sown, the larger ones being slightly covered with soil, the smaller ones not. The whole of the top soil is then moistened with a sprayer and covered, either with a sheet of glass, or a glass dome, the vessel being kept warm. Within 8 to 14 days the seeds will have germinated and the glass sheet or dome can be slightly raised with a splinter of wood. About three weeks after germination the minute seedlings are to be transplanted into tiny pots, where they remain for one and a half years. During the winter these young seedlings must receive a little more water than the mature plants.

Protective Coloring in Insect Life

By HERBERT C. McKAY

(*Continued from page* 1096)

green areas. This coloration renders the insect inconspicuous upon vegetable growths as well as upon green lichen and similar growths.

Among the smaller insects, there may be found many examples of true imitative coloration. In the case of the mantis we have an insect about one-half inch long in life, which is to all intents, invisible as long as it remains motionless. The first plate shows this insect in all of its striking markings, as vivid as those of a tiger or leopard, but when placed upon the background of the lichens which form its native habitat, it becomes invisible to the casual glance. This coloration depends not upon exactly matching the pattern of the ground, but upon the absence of any extensive area of uniform shape or color. The broken colors destroy all outlines and blend perfectly with the background. This coloration is a part of the natural coloration of the insect.

The Lichen-louse acquires its protection in quite a different manner. The photograph shows that this insect is a mass of fine, but long hairs and spines. The insect secretes a mucilaginous substance not unlike that which forms a spider's web. This is pulled about and forms a mass of fine web, completely covering the insect. This in turn picks up tiny bits of lichen, pollen and other debris until the motionless insect very closely resembles the lichen upon which it lives. Only when it is in motion is it clearly visible. Here the protection is not a part of the creature's congenital investment, but an acquired coat of camouflage.

Among the smaller insects, those which measure but a sixteenth of an inch or less, there are several examples of the same type as that of the Mantis, but being so small, the design is comparatively larger and more simple. In such a case the only protection necessary is a slight mottling which will serve to blend the colors of the insect with those of the background. In all of these cases, the coloration is composed of various tones of gray, as the insects live upon the lichens which cover the three trunks.

So extensive is this phenomenon that a young lady of Florida, who has been making a study of the lichens of that state, is now devoting considerable time to the study of the protective coloration of these tiny creatures.

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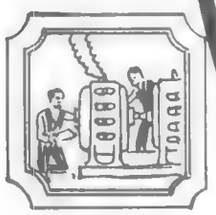

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answer to their various questions. She now proceeded, by calling for Yogi Monton, the high priest of the East, the spirit force of her soul, the seer of the future. With deadly silence, the spectators sat gazing at the bottle. In ghostly fashion, the ball began to sway. More pronounced came the action, the swaying continued, until finally, it struck the side of the bottle, and a clear tone, caused by its striking the glass, was heard throughout the room. "The Yogi will speak for us tonight. He seems pleased. He answered more rapidly than usual." Thus spoke the silver-haired mystic. "For those not familiar with the Yogi's tongue, I will ask him to tell us how he answers for "yes." "Tell us, Yogi Monton. Speak through thy language of the dead. Tell me through thy vision of the mystic . . . how you will answer for yes" Again the little ball, suspended in the bottle, began to slowly sway to and fro, until it finally struck the side of the bottle, and another clear note was heard. The swaying subsided, and once more the ball hung motionless. "The Yogi means that for yes, the ball strikes but once." And how will you answer for no, great spirit of the unknown sphere?" Once more the swaying of the ball began, which continued until two distinct notes were heard. "Twice for no, is the language of the dead," the little lady continued. "We will now proceed. We will begin with you, Mrs. Baxter," said the medium, pointing to a lady in the extreme opposite corner of the room. "Ask what you will of the Yogi Monton. His spirit will answer."

"Is my daughter well and happy in the other world?" asked Mrs. Baxter in low and trembling tones. The ball answered . . . yes. "Does she ever think of me, and the dear ones she has left on earth?" Again the ball answered . . . yes. "Is she with uncle Albert?" Once more the distinct ring of the ball hitting the bottle was heard throughout the room. Several more questions were thus answered for Mrs. Baxter, and the elderly lady informed us that Mr. Anderson would now ask several questions. With sincerity in his tone, Mr. Anderson proceeded. "Is my dear wife, Alice, very happy where she is?" Yes . . . answered the ball. "Does she know all that goes on here with us?" Again . . . yes. And so on, and so forth, came the questions, from Mr. Anderson, Mrs. Nevins, Mr. Caldwell, Mrs. Cambringe, etc., etc., etc. For an hour the séance continued, and the little ball did all the talking, guided, of course, by the mystic spirit of the east, who spoke through the mind of this clever medium. So thought her believers. My viewpoint in the matter was quite different. A stubbly little gentleman, seated in the farthest corner of the room, had rather a restless foot, throughout the entire proceedings. Although he was seated in the darkest and farthest corner of the room, and in spite of the fact that the illumination was rather dim, I managed to observe that his foot controlled the little ball. My readers are undoubtedly familiar with the ever popular pneumatic trick plate-lifter, securable in novelty shops. This medium had one of these planted beneath the carpet. The rubber ball end of the lifter was directly beneath one of the table legs, upon which the mystic bottle stood. The other free end the gentleman managed to manipulate beneath the sole of his shoe, and, wearing what appeared to be a size ten shoe, rather large for the little gentleman, he apparently had no difficulty in causing the bottle to speak. Pressure upon the ball caused the table leg to tilt and naturally caused the ball to sway. This gentleman, who took great pains to speak highly of the medium's ability, before the proceedings started, must have been the re-incarnated spirit of the Yogi Monton. When the tapping of his shoe subsided, the mystic voice of the Yogi priest was silent.

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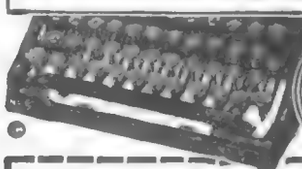

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Gunprints Help to Catch Gunmen

By H. H. DUNN

(*Continued from page* 1091)

their fingerprints under the present system.

"The discharged and empty cartridge or 'shell' carries two separate and distinct 'gunprints', neither of which is or can be duplicated except by firing another cartridge from the same weapon. One of these marks is left by the firing pin; the other by the breech against which the cartridge recoils at the instant of firing.

"Two more 'gunprints' are carried by every bullet. One of these is left by the grooves of the rifling, which are never duplicated, and cannot be duplicated, in any two arms, even of the same make and model. Man has not yet devised a method whereby he can eliminate a variation of a few thousandths of an inch from groove to groove in the barrel.

"The other 'gunprint' on the bullet is left by minute irregularities in the surface of the inside, or 'bore' of the weapon. Each of these irregularities engraves its permanent autograph on the bullet as the latter passes out.

"Not only do these marks differ individually for each firearm, but *they are always the same, always identical, for each particular weapon.* They cannot be eliminated without destroying the gun. It is true that, the more a barrel is used, the more it develops rust spots and fouling blotches, but these are readily visible, and leave marks on the bullet quite distinct and apart from the original 'gunprints.' More than this, the criminal, as a rule, keeps his weapon perfectly clean and in first-class condition, since his life depends on its efficiency.

"The flattening of the nose of the bullet, in a wall or against a bone in the human body, does not militate against identification, since the essential markings are at the base of the bullet. These markings consist of fine lines, so fine, in fact, that the ordinary microscope, in many instances, will not reveal them.

"By micrometric measurements, microscopic studies, and photographic enlargements, however, it is possible to establish, first the caliber, second the name of the manufacturer, and, third, the individual weapon from which the bullet was fired. The same is true of the ejected shell, when the latter is found, which is more rare than the recovery of the fired bullet."

In the development of this new study, the Berkeley police department, and other identification bureaus on the Pacific coast, are establishing files of "gunprint" identification cards, along the same lines as fingerprint files are maintained. Eventually, through these indexes it will be possible to identify the gun used in San Francisco today with one found in New York four or five days later, and similarly for other cities.

The method of comparison is much simpler than that of fingerprints, since a description of the bullet or cartridge, with details down to one-thousandth of an inch, can be written down and transmitted by telegraph. When the suspected weapon is found, it is a simple matter to fire a bullet from it, and compare the "gunprints" on bullet and cartridge with those established at the point where the crime was committed.

It is expected that reputable manufacturers of firearms will co-operate with police identification departments in this development, by providing them with shells and bullets fired from the weapons they make. It should thus be possible to build up an identification file of "gunprints" much more comprehensive than any fingerprint file yet made.

The new science gives an individual character to each weapon, as well as to each ejector, each breech-block and every barrel.

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The raised parts of the rifling in the bore of a firearm are known as "lands," and it is on these lands that the minute excrescences appear which cause the individual markings on the bullets. Similar markings, projections and depressions—all microscopic in character and size, are found on the firing pins, hammer-tongues, and ejectors of the weapons, each one leaving its changeless, individual mark on the cartridge.

Richardson has devised delicate instruments for this work, not all of which can be described, because he has not yet completely protected his patent rights on his inventions. Among them is an automatic measuring device; a particularly accurate weighing machine; a camera arrangement for making microscopic photographs, and immediately enlarging them, and a system of record-keeping which gives every bullet and every cartridge a history and an identity of its own.

The gunman or the murderous burglar, as well as the sneaking assassin find in this new science a tireless detective, accompanied by a mute but irrefutable witness—the very bullet with which death was done. The criminal may be too clever to leave fingerprints, but, if he uses a firearm, there is no way he can prevent the leaving of gunprints by which the new scientific detective can identfiy him.

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TUNE IN ON WRNY

Famous Inventors I Have Interviewed

By H. WINFIELD SECOR

(*Continued from page* 1100)

by radio amateurs in all parts of the United States.

Another invention of Dr. Rogers is a special form of receiving loop aerial, which is so designed with dozens of wires stranded and spiraled all over it, that it has a greater efficiency than any other form of loop so far designed. Dr. Rogers believes with Dr. Tesla that the major part, if not all of the radio wave energy transmitted to a receiving station is carried through the ground, and *not* through the space above the earth's surface.

One more inventor whom the speaker has interviewed at different times, and whom all radio broadcast fans and amateurs know, is Dr. Lee de Forest. Dr. de Forest, a very charming gentleman, is known the world over for his many inventions in radio, but particularly of course for his invention of the three electrode, vacuum tube or audion, as he calls it. Dr. de Forest has had a long struggle with this child of his brain, but those who know him are glad that at last justice has been done, and he has been legally recognized by the courts as the inventor of the three

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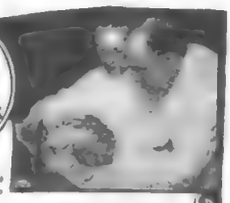

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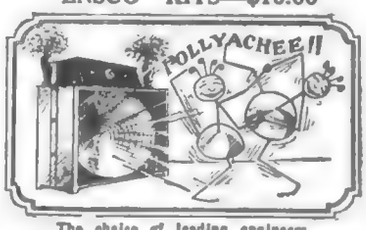

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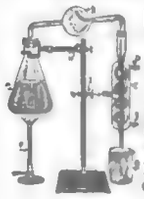

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electrode vacuum tube. It would seem hardly possible that a simple addition of the third electrode or grid in the vacuum tube would have spelled all the difference in the world between failure and success, but we know perfectly well now that it does make all the difference imaginable. Without the de Forest audion, we would not have the easy and perfect means of amplifying the radio broadcast concerts which we now listen to. It took the genius and persistence of a man like Dr. de Forest, to keep on playing with a delicate laboratory toy, such as the audion was twenty years ago, to make of it a successful commercial device.

Dr. de Forest has in the past few years earned new laurels by his invention of the talking movie, known as the *Phonofilm*.

The writer first interviewed Dr. de Forest in 1910. At that time Dr. de Forest had his laboratory in the vicinity of Grand Central Terminal. This prolific inventor was investigating, among other radio devices, the efficacy of various gases when used in the chamber enclosing an arc between carbon and other electrodes. A few years later the de Forest radiophone transmitters and receivers, the former using a modified form of arc, were installed on a number of U. S. naval vessels with considerable success.

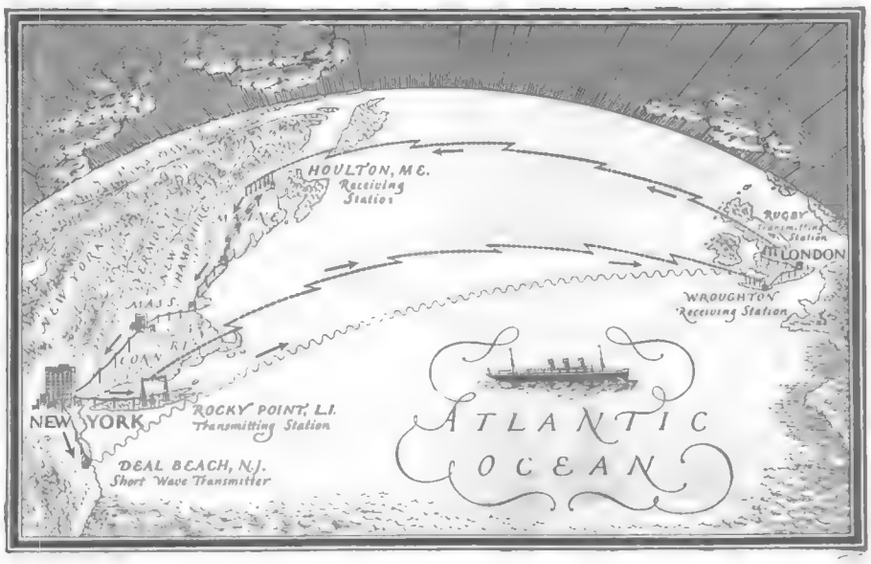
In the years between 1910 and 1914 Dr. de Forest carried on a number of experiments in radiophone transmission from an antenna on the Metropolitan Tower, and arias from the opera were sung by a prominent artist and heard on shipboard far at sea. Thus, Dr. de Forest is a real pioneer in radio broadcasting.

At this time the writer visited Dr. de Forest's laboratory again, and as he thinks back he remembers a device which he saw at that time, about 1910, which will bring a smile to many people's faces if they think the latest, single-dial control radio receiving sets are purely a product of engineernig genius of the past year or two. The writer saw a one-dial control set at that time in Dr. de Forest's laboratory, which was built in the form of a desk, much on the order of some of the present-day sets which tune in the stations on a single dial, but which provide further latitude in improving the signal by tuning with the other condenser dials afterward.

This early one-dial set provided the same facilities for tuning. When you pulled out the main tuning knob, all of the variometers and variable condensers moved simultaneously. Once the station was heard, the knob could be pushed in and the other dials tuned individually.

The radio amateurs of America have to thank Dr. de Forest for the introduction of the first vacuum tubes, or "audions," as he called them, and which became available to the experimenter in 1909. These vacuum tubes were of the filament-grid- and plate type, and were spherical, with a diameter of about 2¼ inches. The writer remembers making up many "B" batteries for these early vacuum tubes out of flashlight cells. It is interesting to consider that it was several years before any one made the discovery that by means of regeneration, the strength of a signal could be amplified tremendously with a single tube. All of the early amplifiers were of the straight cascade type; that is, comprising two or more stages of amplification, the vacuum tubes being coupled by means of 1 to 1 ratio transformers. These transformers frequently were composed of three small spark coil secondaries having a core of soft iron wire placed inside. The whole affair was placed in a box filled with wax.

Dr. de Forest demonstrated at an early date one of his vacuum tube amplifiers, comprising half a dozen stages, which surprised every one who heard radio code signals coming in from the antenna, which, when passed through this amplifier, could be heard all over a large lecture hall at Columbia University.



The Radiophone's Meaning

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It was then demonstrated that there was a real use for telephone communication between the world's two greatest cities. It was further demonstrated that the American Telephone and Telegraph Company, with the co-operation of the British Post Office, was able to give excellent transmission of speech under ordinary atmospheric conditions.

In accord with announcements made at that time, there will be a continued effort to improve the service, extend it to greater areas and insure a greater degree of privacy.

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The Sun and Its Neighbors

By W. J. LUYTEN

(*Continued from page* 1107)

dashing along at the rate of more than 100 miles a second. And curiously enough, where the institution of a "one way street" is totally unknown for the stars with small speeds, there is a definite one way regulation for the speeders. They can only move in a southern direction, to a point about half way between Sirius and the South Pole, and they may not go back. There are no rules about lights, although, of course, those "dark stars" running along without their lights do so at their own risk. Parking limits are totally unheard of. So far as we know, it is perfectly allowable for a star or even a group of stars to occupy the same portion of space for a couple of million years. Sometimes two systems of stars or star clusters such as the Ursa Major cluster linger in the same region for quite a while, they become thoroughly mixed up, but after they have finished their conversation they unscramble again and each goes its own way.

This brings us to the question of collisions. If things are running as wild as all that, surely we might expect frequent collisions? Far from it. Compared with their own sizes, the mutual distances of the stars are so enormous that there is no danger of a collision. The stars are so thinly scattered through space that if we represent an average star by an orange placed on top of the Woolworth tower in New York, then the star, also represented by an orange, would have to be on top of the Ferry Building in San Francisco! To make the picture complete we must credit these oranges with the average motion of the stars, which on this small scale, one to thirty billion (1:30,000,000,000) amounts to a mile a century. Once you imagine very clearly this model of the two oranges, one in New York, one in San Francisco, both moving no more than a mile a century on the average, and in any direction they please, you will see why there is no danger that they will ever meet on the prairies of Nebraska or Iowa. For the present we are safe, quite safe; a collision between the sun and another star will not take place. If it should ultimately happen, the astronomers will warn you several thousands of years in advance and give you ample time to arrange for celestial collision insurance.

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Most of the shares of stock for these perpetual motion machines are being sold at a rate of $1.00 per share, although some inventors are trying to sell shares of stock at $100.00 per share.

Therefore the editors of this publication say, "Just come in and show us—merely SHOW us—a working model of a perpetual motion machine and we will give you $5,000.00. But the machine must not be made to operate by tides, winds, water-power, natural evaporation or humidity. It must be perpetual motion."

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Home Mechanics

By W. J. BUTTERFIELD

(*Continued from page* 1118)

good workman, he will have better and more durable furniture.

Having decided on the amount of mill work required, and having obtained an estimate for work and lumber, let the mill man have his time to work out your little mechanical problem, and you will find, in due time, that you have a marvelous collection of well shaped and prepared materials to start work with.

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Radio Wrinkles Wanted!

The Radio Editor, Mr. J. Francis Clemenger, wants to hear from you, if you have a good idea or wrinkle. Make a pencil or pen and ink sketch of the contrivance, write 50 words or so of description, and mail to the Radio Editor, c/o this magazine.

We have made provision for all the tenons and mortises to be of one size ($\frac{1}{2}$" high, 1" long and $\frac{3}{4}$" wide), and all of the cross pieces or "rails" to be of the same size lumber ($1\frac{1}{4}$" × $1\frac{3}{4}$"). The eight end rails for both the seat and table are identical in length (9" from shoulder to shoulder with two $\frac{1}{2}$" tenons 10" in length over all). The front and back rails for the seat are 16" long from shoulder to shoulder with two tenons $\frac{1}{2}$" high or 17" over all, and the three similar rails for the table are $26\frac{1}{2}$" from shoulder to shoulder; they also have two $\frac{1}{2}$" tenons, making each $27\frac{1}{2}$" over all. Care must be taken to have the mortises cut so that the rails will occupy the positions shown in our diagrams.

When the mortises and tenons are properly fitted (and numbered for reference in setting up) the whole frame, both of the table and seat, is put together, using a wooden mallet and block of wood for driving the joints together and in separating the parts again for gluing. If everything fits right, the parts are then glued, clamped or held together with a rope turn-buckle, and placed aside to dry. Heavy weights placed on top of the frames will hold the legs down in place. A square should be used in making the legs stand perpendicular and

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square to the top, before the glue has dried or set. The mallet and block of wood is used for driving at the gluing stage also.

The directory receptacle or pocket, including the two table tops, is next fitted and glued. The process consists in placing the four corner pieces in place and securing them with screws and glue in the manner shown. The four sides are then fitted in the frames thus formed by the corner pieces and two tops. They are to be fitted tightly all around and afterwards glued into their separate frames. The corner pieces are made by using a strip of wood 1¾″ square and of a length sufficient to make the four corners. This is run through a buzz saw four times to cut out the rabbets fitting the ½″ board for the sides. The piece is then sawed diagonally to form the level back illustrated. Afterwards the strip is sawed in lengths and used as described. Where a fine saw is used there will be no need of finishing the rabbets or the diagonal back. The outside edges and the sides are smoothed down flat, after gluing, and should be as one piece of wood. A plane or sandpaper on a block of wood is used for smoothing.

The directory receptacle thus formed and the top for the seat are both fastened to the leg frames in the same way. A frame made of 1¼″ × 1¼″ lumber is fitted within the opening formed by the legs and top rails. The second or extra frames are screwed both to the seat top, directory receptacle, and the top rails of the leg frames as shown.

A back screen for the top of the table is also provided. It is made of ½″ wood and is joined and glued at the corners in the manner shown. Long brads can be driven into holes made with a smaller brad awl to hold the corners more securely. It is better and safer to drill the holes with a twist drill. The screen is fastened to the top with wooden dowel pins glued to the screen and to the top. The screen parts are sawed and finished before gluing.

A telephone screen is shown. The top (6″ × 8″) is made of a single piece of wood 1½″ thick and is shaped by hand. A drawer pull of glass or other material is attached with a screw (as illustrated) for the purpose of lifting the screen. Mortises are cut in each corner to receive a projecting end of each of the four corner pieces. Screws and glue hold the corner pieces and the top together. A small square of the rim or finish at the bottom of the screen is also fastened to each of the corner pieces (see illustration). A series of four frames are first made of the corner pieces, top, and bottom rim, as in the case of the directory receptacle. The sides are then fitted and glued as before described. The lumber is ¼″ for the sides, 1¼″ × 1¼″ for the corners, and ¼″ × ½″ for the rim. Wooden plugs are glued in the deep countersunk screw holes to finish the top surface both in the telephone screen and directory inclosure. The grain of the plugs must correspond with that of the top.

The furniture is stained with any desired stain suitable for the kind of wood used. When dry, it is rubbed down or smoothed. Fine sandpaper is used for this purpose. It is then varnished with furniture varnish followed by a second and a third rubbing, using powdered pumice and rubbing oil on a cloth or leather pad. Then give the final varnishing.

TOOL LIST

The tools required for building will vary with each mechanic perhaps, but he will find handy a good crosscut saw, small smoothing plane, compass or keyhole saw, large hand drill or brace and set of bits, several sizes of wood chisels, rabbeting plane, and sandpaper both fine and coarse.

Send us your ideas as to articles you would like to see described in this Department.

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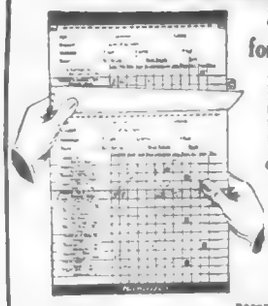

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Building a Model Tugboat

By PROF. F. E. AUSTIN

(*Continued from page* 1128)

The curve of the plan is easily obtained by marking out a rectangle on paper or on cardboard, twenty-two inches long and six and three-quarter inches wide; drawing lines one inch apart and parallel to the ends of the rectangle as shown in Fig. 1 and measuring in from the longer side of the rectangle along each parallel line the proper distance in inches as indicated. A smooth curve can then be traced in with a soft lead pencil through the proper points. An even, flexible strip of wood can be pinned to the board or held by weights and the curve drawn with this as a ruler.

After a cardboard half pattern has been traced out, it can be cut out by using the small sharp blade of a penknife or a pair of tinsmith's shears.

The cut-out half pattern can be held flat on the surface of the soft white pine board that is three-fourths or seven-eighths inch thick, and free from knots, and one side of the hull marked out with a soft lead pencil. the half pattern is then turned over and the other side of the hull plan is marked out.

The board is then sawed out along the pencil marks using a key-hole saw. Work slowly with the saw so as not to bend or break the small blade. If the blade happens to get bent it can be gently bent back again with the fingers.

The inside of the hull sections is sawed out as indicated in the left-hand half of Fig. 1, so that when the sections are screwed together the hull will be all hollowed out inside.

In locating the holes for the screws be careful that no screw will hit against one below it.

The holes are countersunk for the heads of the screws. After the sections of the hull are screwed together the outside is finally shaped by use of a chisel, a gouge and a spoke shave. The screws must have been so located as not to interefere with this work. Sometimes a flat and a half-round wood file can be used to good advantage in smoothing the outer surface of the hull. You can get an idea how near alike the sides are when shaping by comparing the corresponding curves made by the joints of the sections. The final smoothing of the outside of the hull is done by rubbing it with No. 1 and No. ½ garnet sandpaper. Always leave the sandpapering for the last smoothing process as the sharp edges of all kinds of wood working tools will be dulled if the tools are used to cut away surfaces that have been sanded. This is due to the fine, hard particles of sand that become stuck in the wood fibers.

After the outer surface of the hull has been well smoothed over, the sections may be taken apart and their entire surface brushed over with a heavy coating of raw linseed oil. After this has well dried into the wood, for at least twenty-four hours, a thin layer of thick white paint or of white lead putty (not

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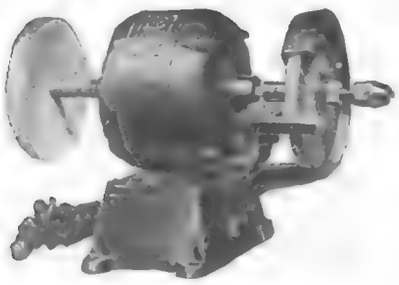

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ordinary window putty but the real white lead paste, before it has been thinned with oil) should be spread over the surfaces of the sections that lie on one another, using a putty knife or an old case knife. Reassemble the sections, screwing them together tightly to squeeze out all excess white lead and to make the joints tight. All excess white lead should be scraped off and after drying for several days the outer surface should be again smoothed over with sandpaper.

The keel may next be screwed to the bottom of the hull. The keel should be of soft pine wood, about three-eighths of an inch wide, about one inch deep at the stern and slightly deeper at the bow end.

Boring the hole through the keel and the stern for the propeller tube will require some care. A one-quarter inch twist drill is used for this. This tube is shown in Fig. 3.

Short pieces of smaller brass tubing are soldered into the ends of the propeller tube to serve as bearings for the one-eighth inch diameter propeller shaft.

The hole for the propeller tube is bored with sufficient upward slant so that when the propeller tube is in place its inner end is above the loaded water line of the hull; which does away with a tight and hard working stuffing box, greatly reducing friction.

The propeller is a three bladed one and may be marked out on a stiff sheet of tin or of brass, by using sharp pointed dividers. To get the blades the same distance apart, mark out a circle two inches in diameter and step off the length of the radius around the circumference. Using every other point will give three points equi-distant apart.

The propeller is soldered to the one-eighth brass rod by holding the two pieces over the flame of a small alcohol lamp, using a bit of soldering flux. The screw shape or the pitch is given to the propeller blades by gently bending them with the fingers. The rudder is made from a piece of tin or brass soldered to a piece of one-eighth brass rod for a rudder post.

A small cog wheel is held on to the inner end of the propeller shaft by means of a small set screw, which allows the quick and easy removal of the propeller.

A cog wheel one-half as large is held on the motor shaft by a set screw.

Wirekraft--$3,000.00 in Prizes

(*Continued from page* 1113)

Rules of Wirekraft Contest

THIS is a wirekraft contest. Hence wire is to be used in the construction of all of the models entered in this contest.

The size of the wire to be employed is limited. The heaviest wire must not be larger than No. 8 American or B and S gauge, and the smallest no smaller than No. 30 B and S gauge—or (for foreign countries not having these exact sizes), the nearest available equivalent.

No. 8 B and S gauge is .12849 inches in diameter or 3.264 millimeters. Its nearest equivalent in the Birmingham or Stubs iron wire gauge is No. 18. In the Stubs steel wire gauge it is No. 30; in the British Imperial Standard it is No. 10. The nearest wire to No. 30 B and S gauge which is .01002 inches or .2546 millimeters in diamcter is No. 31 in the Birmingham or Stubs iron wire gauge. In the Stubs steel wire gauge it is No. 80; in the British Standard it is No. 33.

The builder may avail himself of the opportunity of using any intermediate sizes of wires between No. 8 and No. 30, B and S gauge.

The wire may be copper, brass, iron, steel, or these materials coppered, tinned, nickel-plated, or galvanized, or the wire may consist of an alloy. Any kind of wire available on the market may be employed.

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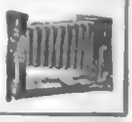

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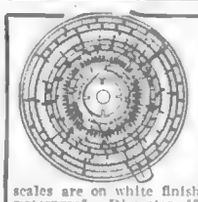

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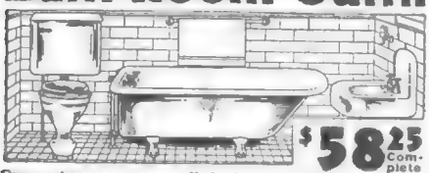

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which rusts easily or for color effects, the models may be painted, lacquered, varnished or otherwise covered.

Any additional decorations or accessories may be employed to enhance the effect. (Example: Silk on a lamp shade; glass in decorative fixtures; electric motors for operating mechanisms, etc.)

Only those portions actually constructed of wire will be judged.

(Example: A reed basket is suspended from a wire chain. The basket not being made of wire is NOT considered. On the merits of the chain only will the prize be awarded.)

Wires may be twisted, spliced, soldered, welded or bound together. Wire may be used to bind other wires together. If soldered a non-corrosive soldering flux should be employed.

There is no limit to the size of the models which may be entered nor to the number of entries which any maker may submit during any calendar month.

In every case the model must be forwarded express prepaid to SCIENCE AND INVENTION Magazine. It should be tagged with name and address of the maker, who will prepay charges if model is to be returned.

The first prize will always be awarded to a model possessing the greatest utilitarian merits. This must be an object NOT found on the market today.

The second prize will always be awarded to an object possessing the best decorative artistic or constructive effect. It may be a replica of an existing object or a model of an imaginative object or effect.

The remaining prizes will be judged from either one or the other viewpoints at the discretion of the judges.

All models may remain at the office of this publication until the close of the contest at the discretion of the editors.

This contest starts January 1st, 1927, and will terminate January 1st, 1928.

This is a monthly contest lasting for twelve months, each monthly contest closing on the first of the month following dates of issue. Thus the contest for the month of March, 1927, will close April 1st, 1927. Winners for March will be announced in the June Issue.

Address all entries to Editor Wirekraft

SCIENCE & INVENTION MAGAZINE,
230 Fifth Avenue, New York City

$3,000.00 In Prizes
Arranged in Monthly Awards

First Prize	$100.00
For Utility Only	
Second Prize	50.00
For Artistic, Decorative or Constructive Effect—may be a replica or model of some imaginative or existing object.	
Third Prize	25.00
Fourth Prize	20.00
Fifth Prize	15.00
Sixth Prize	10.00
Seventh Prize	7.50
Eighth Prize	5.00
Ninth Prize	3.50
10th to 16th Prizes of $2.00 each	14.00
Total	$250.00

Tools Required

THE tools required for the construction of Wirekraft articles may be found in the Dec. issue of this publication, a reprint of which will be sent free upon request. The following tools may be used advantageously:

1 pair flat-nosed pliers. 1 pair round-nosed pliers, 1 wire cutter, 1 hacksaw, 1 small vise, 1 soldering iron.

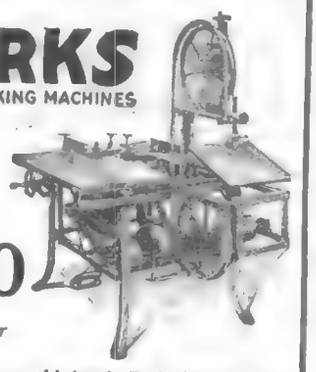
The materials which are necessary are:

Solder, soldering paste or flux, nails, one piece of wood, and most important of all, wire of the sizes specified in the contest rules and regulations.

If the builder decided to weld his wires together, a small welding transformer or a storage battery may be used for this purpose. For the formation of long cylinders, a coil winding machine or a lathe may be advantageously employed. Toy motors for the operation of any devices constructed of wire could of course be procured and added to the model and the addition of miniature sockets and bulbs to illuminate the interior of any buildings constructed of wire might also find a place in some of the constructions.

PARKS
WOODWORKING MACHINES

Cabinet Shop Special



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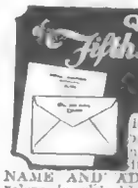

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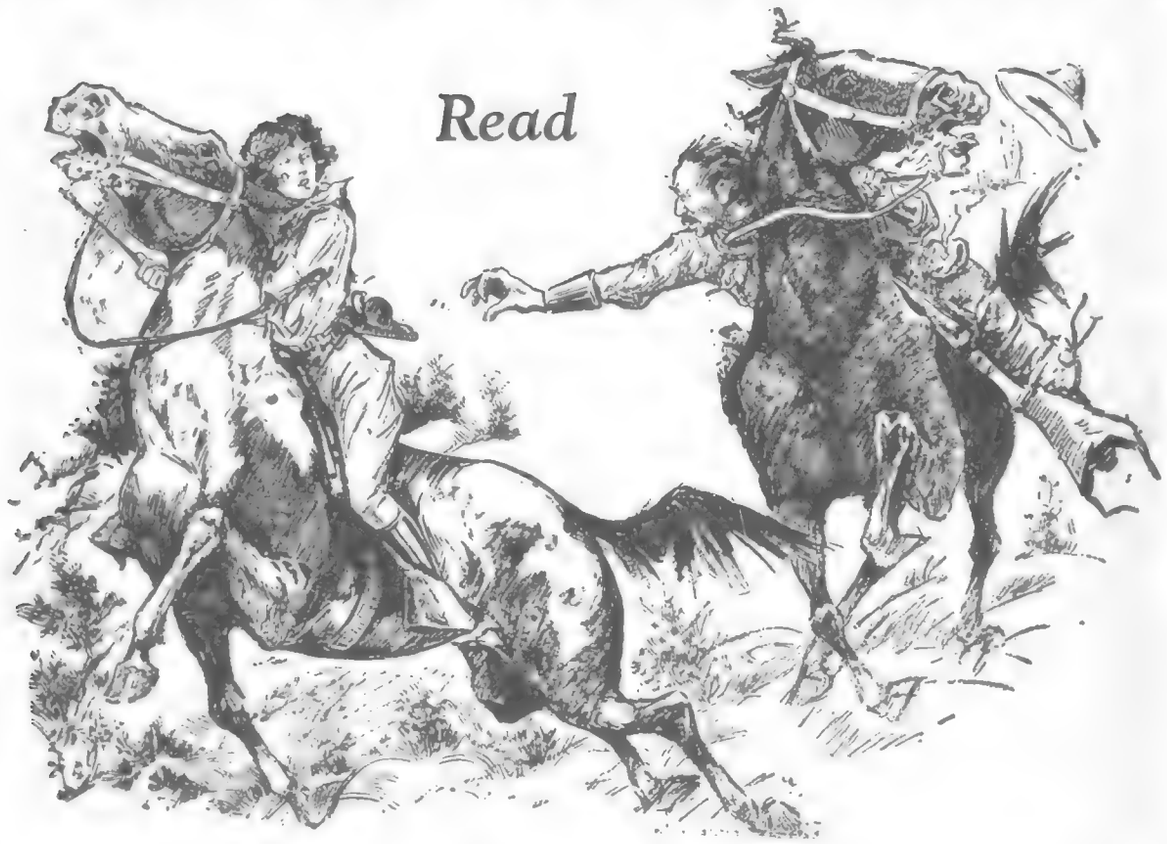

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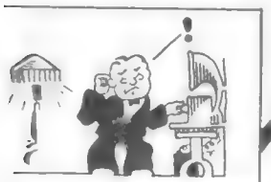
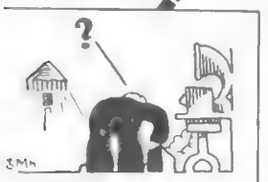
THEN

7 P.M.~Rushes supper to tune in big DX,



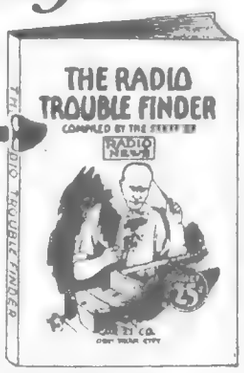
7 30~Discovers set wont work,



9 P.M.~Still trying to locate trouble,

12 P.M.~Gives up in disgust!

he bought



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Among the outstanding radio publications of the new year is this first encyclopedia of radio information to be published in book form in this country. Aside from its practical purpose, the appearance of this volume sets a definite milestone in the history of radio progress, being in essence a comprehensive and compact review of all that has come into existence in knowledge and achievement in the field of radio up to this time.

The compiler has aimed to provide not merely a dictionary of radio terms, but an actual ready-reference encyclopedia and practical handbook for the most general all-around application. Its classification of references covers every item of importance relating to radio or the radio industry. The text comprises 1,930 definitions of words, terms and symbols which have a specific application in radio, in concise, concrete, readily understandable explanations. These are further elucidated with over 500 illustrations, photo reproductions, diagrams, and drawings. All of the most modern instruments and their development, every known circuit, new and old and every part and apparatus used in radio are fully described by word and picture. Over fifty references, for example relate to circuits, making an array of practically all the well-known receiving and transmitting circuits. Equally detailed treatment is given on such other fundamental subjects as aerials, amplifiers, batteries, detectors, oscillation, radiation, switches, transformers, units, vacuum tubes, waves, etc. The references are alphabetically listed, and in addition cross-indexed in a supplementary subject classification, grouping correlated subjects and material under appropriate main headings. This adds decisively to convenience of arrangement and practical accessibility of the material. Added interest and educational value is given by the inclusion of brief informative biographies of the outstanding great figures in the development of electrical and radio science, from the beginnings to the latest contributions of the present moment.

This book is heartily recommended to every radio listener. Its definitions are in simple, every day language, so that they can be comprehended by everyone who can read English. At the same time more exhaustive explanations are given for those who require exact technical information.

INTRODUCTION OF PHYSICAL SCIENCE, by Ivor B. Hart. Stiff cloth covers, 5 inches by 7¾ inches. Profusely illustrated, 299 pages. Published by Oxford University Press, New York City. Price, $1.50.

The preface states the intention of this book is to strike a common sense balance between extremes in method. The text is devoted largely to experiments and this is the true way to give meaning to what is sometimes felt to be a dry science. It is very profusely illustrated and in every way is most attractive. As it is intended for instruction the sections are followed by questions and examples, so that after the student has been through a section and done the experiments, he is open to an examination.

AMERICAN PRIVATE SCHOOLS. Stiff cloth covers, 4½ by 7½ inches. Illustrated, 1020 pages. Published by Porter Sargent, Boston, Mass.

The value of this book in the educational field is testified to by the fact that this is the tenth edition, a new book coming out every year. Schools increase so rapidly in number that a work of this character is so soon superanuated and out of date. A very interesting feature may be entitled the introductory section covering the educational year with all sorts of divisions, such as library education, the curious fundamentalist troubles in the South, and all kinds of relevant topics making up nearly a hunderd pages of very interesting reading. Boys' and girls' schools and co-educational schools, are reviewed at great length, and a number of pages are filled with a list of these institutions. It seems a little sad to see a bird's-eye view of the wonderful buildings of the Ely School at Greenwich, Conn., which was destroyed by fire a few weeks ago. The thoroughness of the book which is in rather small print is testified to by the fact that the index of schools takes up over sixty pages and even at that we miss some very familiar names.

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STARLIGHT, by Harlow Shapley. Stiff cloth covers, 4 inches by 7 inches, 144 pages, illustrated. Published by George H. Doran Co., New York City. Price $1.00.

This is a second book of this rather interesting series. It is a popular treatment of astronomy and is so written as to constitute excellent reading. It is quite nicely illustrated and modern astronomy has operated to disclose such marvels of the stars that it really seems the duty of everyone of us to devote some time to the perusal of at least such popular books as this.

THE STORY OF ELECTRICITY, by W. F. F. Shearcroft. Stiff cloth covers, 4¾ inches by 7½ inches, 70 pages. Published by Greenberg, New York City. Price $1.25.

A very simple and nice treatment of electricity is given in this book in seventy-one pages, eight of whch are devoted to title page, contents, etc. This doesn't leave much for electricity but when we find relativity treated in five pages, and the Quantum Theory in less than three, we can only say that the author seems to have a somewhat venturesome personality. Short as the book is it has an index. We are not speaking unfavorably of it by any means, and we are glad to recommend it to our readers.

THE CELL, by Fritz Kahn, M. D. Paper bound stiff covers, 5 inches by 7¾ inches. Profusely illustrated, 66 pages. Published by Albert and Charles Boni, New York City. Price, 40c.

This is a very picturesque treatment of a part played by the cell in plant and animal life. In man there are some thirty thousand billions of cells with a surface area of some six thousand square yards. In other words they would make a sheet about eighty feet on each side. The integument of these cells, the author states, would make a tape four-tenths of an inch wide, which would reach from Washington, D. C., to the City of Providence, R. I. A short index and some very interesting cuts follow it, the latter given in a sort of supplement.

KAFERVOLK, by Dr. Kurt Floericke. Stiff cloth covers, 5¼" x 8", 76 pages. Published by Kosmos, Stuttgart, Germany.

Again we have the mystic seventy odd pages, this time devoted to beetles with numerous illustrations. An attractive colored title page or cover page more properly, tells what the subject of the book is by its illustrations. When we note that the book is published by the German "Kosmos" magazine, we feel that we have reviewed it, for it has all of the attractive features and nice treatment of its subject which characterizes these interesting little manuals.

RADIO UP TO THE MINUTE, by John R. Irwin and Arthur R. Nilson. Stiff cloth covers, 5 inches x 7½ inches, illustrated, 398 pages. Published by Edward J. Clode, Inc., New York City. Price $1.00.

One of the best new radio books is that called "Radio Up to the Minute," by John R. Irwin and Arthur R. Nilson, two well-known radio engineers in New York City. The book covers effectively the history of radio, from the earliest experiments up to late research. The theory of radio is explained by introducing the reader to the principles of magnetism and electro-magnetism, and chapters are included which take up the theory and design of vacuum tubes and the various instruments used in making radio sets. We recommend this book highly as a reference work for the average broadcasting fan and amateur.

THE RADIO NEWS SUPERHETERODYNE BOOK. Soft covers, 8½" x 11¾", profusely illustrated, 92 pages. Published by The Experimenter Publishing Co., New York City. Price 50 cents.

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(Continued on page 1172)

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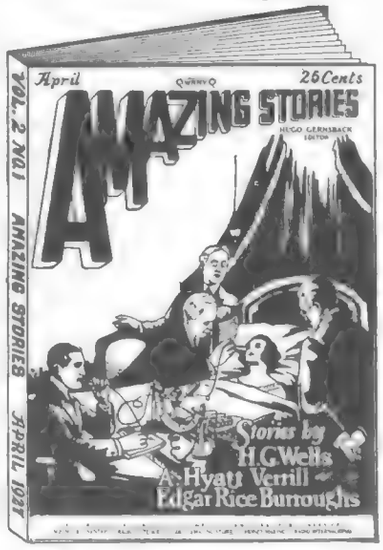
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to Z

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This book contains nearly every form of radio question covering every imaginable subject that one could think of. Most of the answers are accompanied by diagrams of sets and various circuits, all of which will prove extremely valuable of course to every radio man, whether amateur or advanced student. The book is divided into sections and covers such vital and interesting subjects as various types of circuits; amplifiers; radio transmitting circuits; different forms of current supply; questions concerning miscellaneous radio apparatus and their hook-up with diagrams, etc.

HOW-TO-MAKE-IT. Compiled by the staff of SCIENCE & INVENTION Magazine, edited by H. Winfield Secor. Soft covers, 8½" x 11¾", profusely illustrated, 110 pages. Vol. 1. Published by The Experimenter Publishing Co., New York City. Price 50 cents.

This book has had a phenomenal sale and embraces a number of articles, some of which are no longer available, but which have appeared in the columns of SCIENCE AND INVENTION Magazine from time to time. There have been thousands of requests made to the editors of this magazine for copies of these various articles on such practical subjects as home-made oil burners for the furnace; home-made telescopes; building your own phonograph; building home-made drills and lathes from pipe and other fittings; a home-made movie camera; building double-neck harp guitar, etc., that they finally decided to compile this valuable book which has met with instant success everywhere. This book is worth its weight in gold to all home mechanics who like to construct useful apparatus, such as those enumerated above. Besides these things, there are articles describing dozens of how-to-make-it kinks, which everyone will find useful at sometime or other about the house, garage and shop. An air propeller sled is described as well as how to build porch furniture, kitchen cabinets, bookcases, grandfather's clock, rose arbors, gasoline blow pipe, gasoline cycle car, a 1/16th H. P., A. C. motor, a buried treasure finder, motorcycle engined monoplane, as well as ice boats, electric refrigerating machine for the home, and how to build a powerful 10" reflecting telescope.

THE STEAM ENGINEERS HANDBOOK, by the International Correspondence Schools, 298 pages, 46 illustrations, size 3¾" x 5½", published by the International Text-book Company, Scranton, Pa. Price cloth bound $1.00. Leatheroid bound. $1.50.

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(*Continued on page* 1174)

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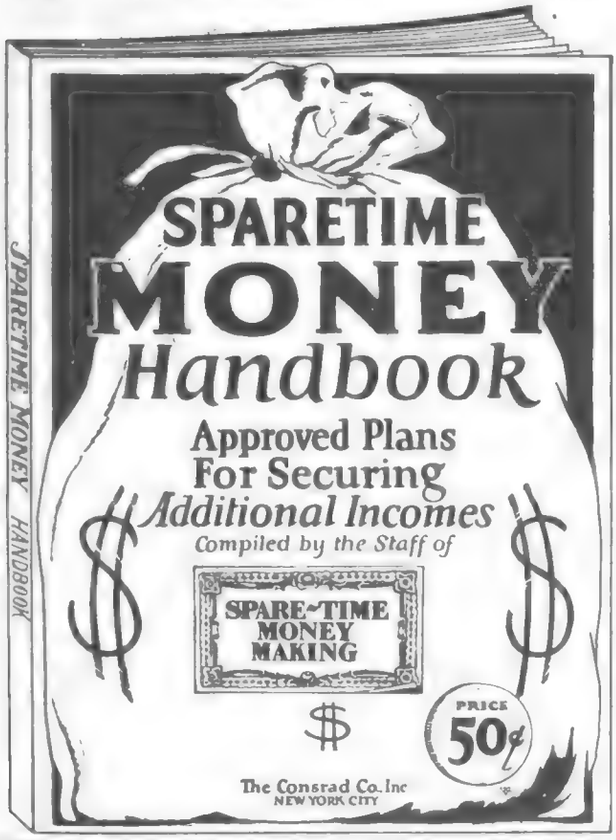

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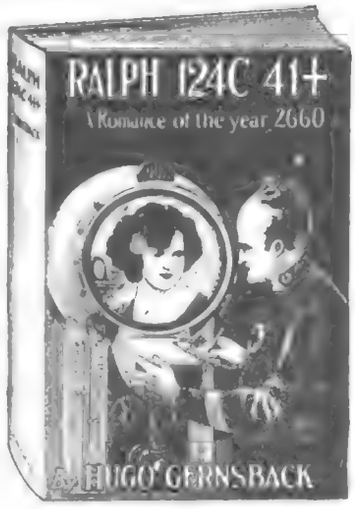

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BUILDERS' BLUE PRINTS, HOW TO READ THEM, by William S. Lowndes, Ph. D., 174 pages, profusely illustrated, size 6" x 8½", published by the International Text-book Company, Scranton, Pa. Price $3.00, including ten folding blue prints.

In this volume the author has endeavored to meet the wide demand for information regarding the reading and understanding of blue prints. The book contains many drawings which greatly simplify the text. The average layman will find it highly instructive and full of information. Carpenters and building trade mechanics will find their progress toward higher positions no longer hampered by their own lack of knowledge regarding blue prints if they study this book conscientiously.

Rules for Matchcraft Contest

(*Continued from page* 1114)

$100.00 Monthly Prize "Matchcraft" Contest

DURING the past year SCIENCE AND INVENTION Magazine awarded $5000.00 for articles made entirely of matches. While this $5000.00 contest has officially expired, the publishers have decided that because of the great popularity in Matchcraft constructions, the contest would continue in force on a new prize rate basis until further notice. The list of new prizes will be found in the center box and the same rules for the first contest are to be observed in this contest.

(1) Models submitted must contain at least 90 per cent. safety matches in their construction.

(2) Models made of toothpicks, paper matches, or non-safety matches, are not eligible in this contest.

(3) Models can not be built around boxes or other supporting articles. Walls, roofs, etc., must all be self-supporting and made of matches.

(4) All liquid adhesives, such as glue, shellac, cements, etc., are permissible.

(5) Models may be painted, gilded or silvered.

(6) Models may be of any size.

(7) In order to win a prize, it is necessary that either models be submitted, or, if this is not practical, owing to their size, a 5"x7" photograph of the model may be sent in lieu of the model itself. The best models submitted each month will be awarded the prizes scheduled herewith.

(8) All models submitted to SCIENCE AND INVENTION Magazine will be promptly returned to the builder, who will prepay all charges.

PRIZE AWARDS

First Prize	$50.00
Second Prize	20.00
Third Prize	15.00
Fourth Prize	10.00
Fifth Prize	5.00
Total	$100.00

(9) Where SCIENCE AND INVENTION has any doubts as to the model (where photos only are submitted) complying with all the regulations, the judges may, at their discretion, request that the actual model be sent in for inspection, paying transportation charges both ways.

(10) This is a monthly contest and will continue until further notice. Each monthly contest closes on the first of the month following date of issue. Thus the contest for the month of March will close April 1st and prize-winning announcements will be made in the June, 1927 issue.

(11) Models must be shipped in a strong wooden box, never in a cardboard box, as SCIENCE AND INVENTION can not be held responsible for breakage in transit due to models having been improperly packed.

(12) When models are sent, be sure to affix tag, giving your name and address, to the model itself. In addition, put name and address on outside wrapper of package.

(13) Address all letters, packages, etc., to Editor, "Matchcraft" Contest, care SCIENCE AND INVENTION Magazine, 53 Park Place, New York.

Caution—Soak or cut heads from matches before building your model so that the models may be expressed or mailed. The strike-everywhere square cut Liberty matches can be used if the heads are cut off.

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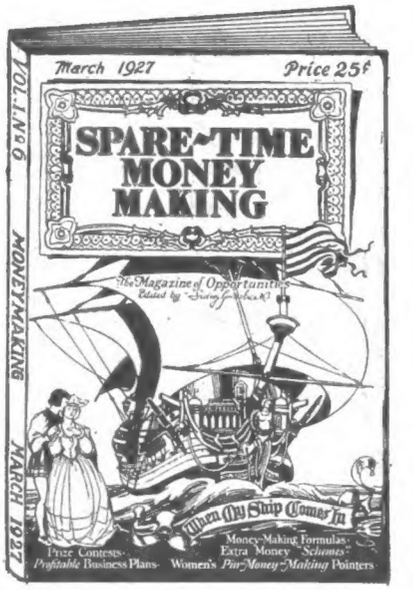

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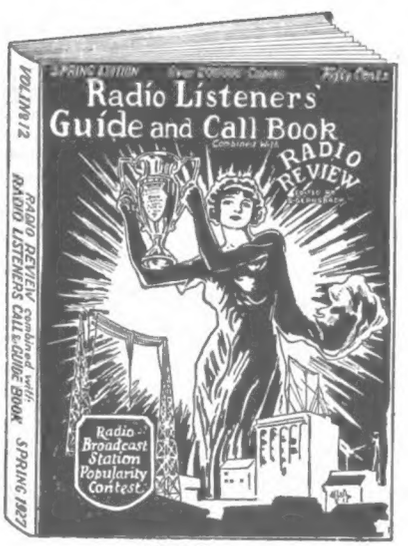

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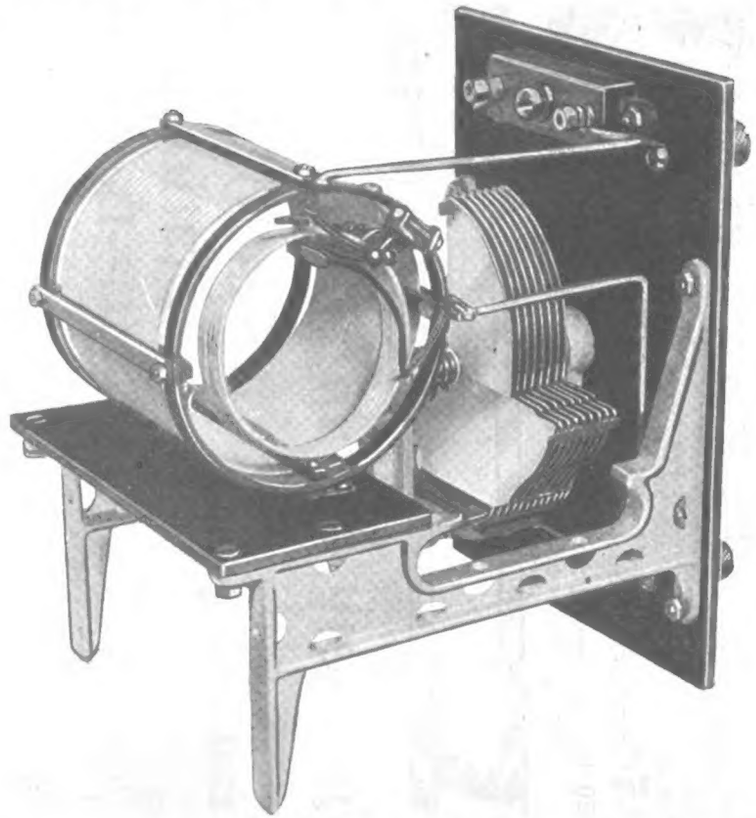

A rear view of the WAVE TRAP showing the location of the various parts

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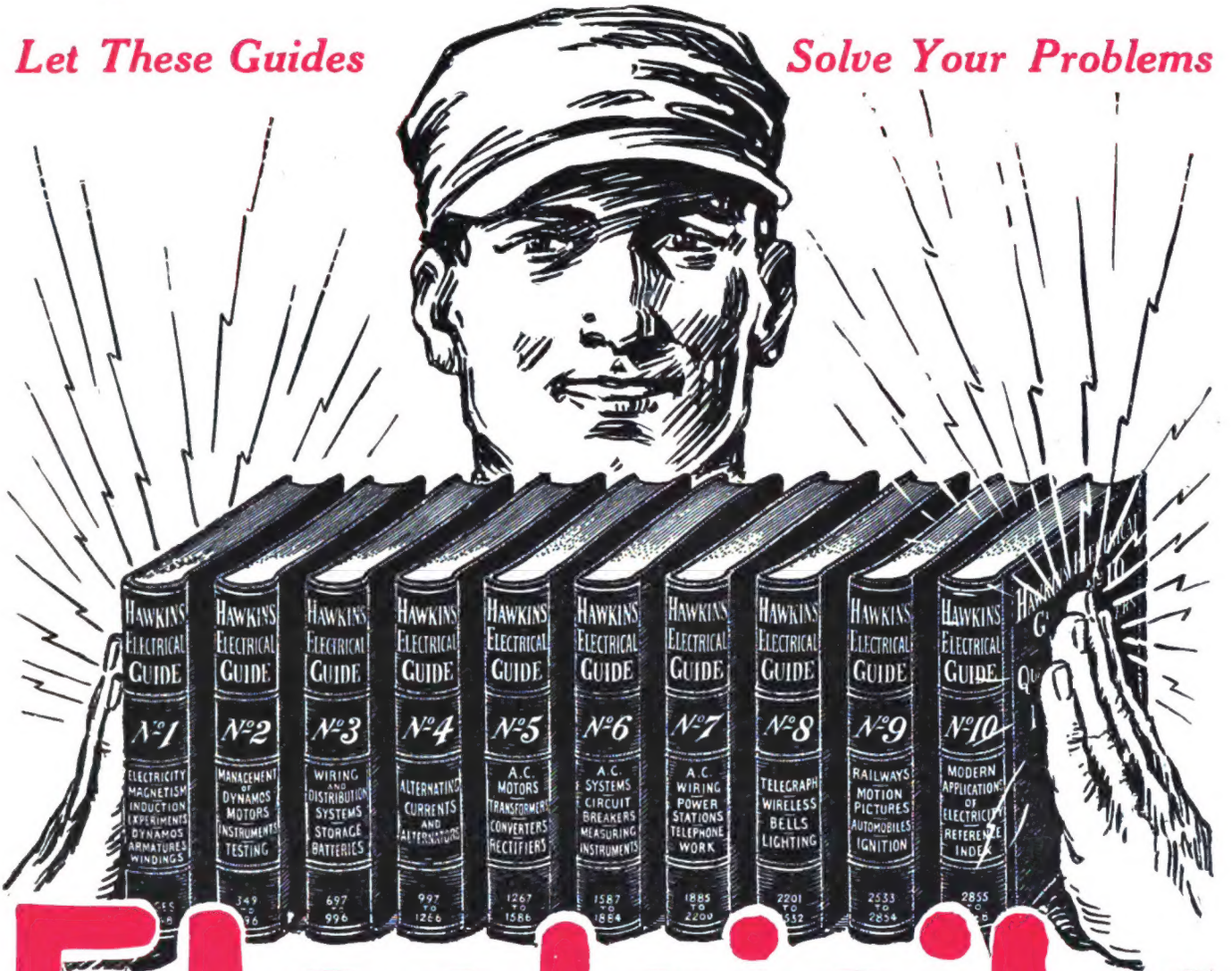

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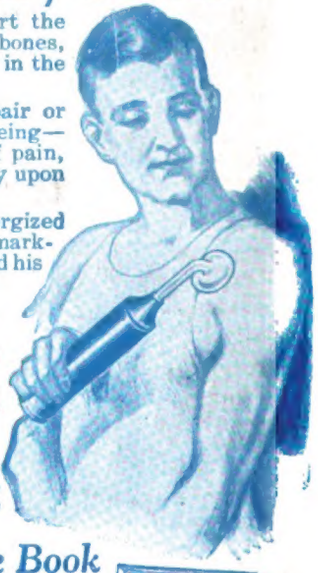

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